JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

SEPTEMBER, 1849.

CIVIL ENGINEERING.

Contributions to Railway Statistics, in 1846, 1847, *and* 1848. *By* HYDE CLARKE, ESQ.

(Continued from page 78.)

No. 9.—*Sand Traffic.* The sand on the Bodmin and Wadebridge, and Hayle Railways, (15,264 tons in 1847,) is sea-sand used as manure. Sand is used for building, agricultural, and domestic purposes. That carried on the Croydon is partly for sanding floors.

The rates are as follows:—

London and Croydon,	3·75*d.*	per ton per mile.
Bodmin and Wadebridge,	3·00	" "
Leicester and Swannington,	2·75	" "
Wishaw and Coltness,	2·20	" "
Arbroath and Forfar,	1·97	" "
Lancashire and Yorkshire,	1·33	" "

On the Durham and Sunderland Railway, ballast is carried for shipping purposes. The return stands thus—

1845.	1846.	1845.	1846.
30,356 tons.	36,567 tons.	£506	£609

No. 10.—*Slate Traffic.* There is little information as to the quantity of slate carried. In the year ending 1846, there were carried on the Wishaw and Coltness Railway 1280 tons, for which £41 were received.

The rates for carrying slates per ton per mile are as follows:—

Ballochney,	3·0*d.*
Newcastle and Carlisle,	2·0
Wishaw and Coltness,	1·3

No. 11.—*Bricks and Tiles.* That railways cause a large saving in many places in the carriage of bricks is shown by the quantities carried. Many new brick-fields and tile-works have been opened to take advantage of these facilities, as well as of the cheap coal,—in the same manner as they are opened near canals.

The rates of carriage per mile per ton are as follows:—

Bodmin and Wadebridge, - -	4·00*d.*
Ballochney, - - - -	3·00
Leicester and Swannington, -	3·00
London and Croydon, - - -	3·00
London and South Western, -	2·09
Maryport and Carlisle, - - -	2·09
Wishaw and Coltness, - -	1·95
Whitehaven, - - - -	1·80

The only return of tiles carried for building or agricultural purposes, is that of the Wishaw and Coltness Railway, for the year ending June 30, 1846, tons 502. Receipts £20.

The only return of clay carried for brick making, pottery, or other purposes, is that of the Wishaw and Coltness Railway, 1846, tons 346; and 1847, tons 475. Receipts, 1846, £6, and 1847, £8.

The rates for the carriage of bricks are generally too high, and are exclusive of loading. Twopence per ton per mile would be enough.

The above returns give no means of calculating the quantity of bricks and tiles carried on the whole length of railway.

No. 12.—*Miscellaneous Mineral Traffic.* Besides the articles already enumerated are many others, as lead ores, copper, brass, lead, and tin manufactured, salt, sulphur, Roman cement, glass, pottery, fullers' earth, &c.; but as to which no information is to be got.

The rates for carrying salt are as follows, per ton per mile:—

Bodmin and Wadebridge, - -	4·00*d.*
Newcastle and Carlisle, - -	2·50
London and Brighton, - -	2·24
Lancashire and Yorkshire, - -	1·32

The rate for carrying fullers' earth on the London and Brighton Railway is 2·24*d.* per ton per mile.

No. 13.—*Mineral Traffic.* The whole mineral traffic shows the following result in tons:—

	1845.	1846.	1847.
Coal and Coke,	7,000,000	8,900,000	8,900,000
Ironstone,	400,000	500,000	600,000
Iron,	230,000	230,000	300,000
Dross,	——	110,000	110,000
Copper and Tin,	23,000	23,000	23,000
Limestone and Lime,	200,000	250,000	300,000
Building Stones,	200,000	400,000	600,000
Sand,	30,000	30,000	37,000
Ballast,	30,000	36,000	36,000
Bricks and Tiles,	2,000	5,000	5,000
Miscellaneous,	——	280,000	300,000

All these amounts, except for coal, are far below the mark; but they es-

tablish a total mineral traffic in 1847 of not less than 11,200,000 tons, besides unenumerated articles.

No. 14.—*Timber Traffic.* The rates for the carriage of timber are as follows:—

Whitby and Pickering,	5·00*d.*	per ton	per mile.
Ballochney,	3·00	"	"
Whitehaven,	3·00	"	"
Bodmin and Wadebridge,	2·50	"	"
London and South Western,	2·50	"	"
Wishaw and Coltness,	2·35	"	"
Maryport and Carlisle,	2·33	"	"
Lancashire and Yorkshire,	2·24	"	"

Timber is, in some returns, mixed up with stone traffic.

No. 15.—*Building Traffic.* On the whole, railways afford great accommodation to the building interests, though not to that extent which they may and will do when the traffic is more developed.

The following is an estimate of the traffic carried on for building purposes under each head:—

	Tons. 1845.	Tons. 1846.	Tons. 1847.
Stone,	200,000	400,000	600,000
Bricks and Tiles,	2,000	5,000	5,000
Timber,	40,000	40,000	50,000
Lime,	50,000	50,000	50,000
Sand,	10,000	10,000	10,000
Total,	302,000	505,000	715,000

The rates for the carriage of each of these articles, though below those on roads and canals, are still too high for the development of the traffic. It is a great disadvantage that most of these articles—stone, timber, and bricks—give much trouble in loading and unloading.

No. 16.—*Fish Traffic.* This traffic is of the greater importance, as it gives a positive addition to the supply of food in the country, and is therefore of great national benefit. Railways stimulate the production, or economise the cost of production, of grain, meat, and other articles of food; but all fish that can be carried inland, is so much added to the resources of the country. In this respect railways have done much, and can do more, both for the supply of food to the country, and the promotion of the fisheries.

In 1845, I estimated the railway traffic in fish at 13,000 tons, which must have been much below the mark.

The following is an estimate of the amount now conveyed:—

Districts.—Scotland,	2,000	tons.
Northern,	4,000	
Midland,	2,000	
Western,	2,000	
South Western,	4,000	
Southern,	4,000	
Eastern,	25,000	
Total,	43,000	

This traffic is very remunerative, and does not bring less than 10*s.* per ton. If parcels were taken into the account, the gross tonnage of fish carried may be reckoned as 70,000 tons; or, on the lowest computation, the food of as many individuals.

No. 17.—*Grain Traffic.* The conveyance of grain and flour is irregular; for though there is a fixed quantity carried to the local markets, the import of foreign corn is fluctuating.

The rates are as follows, per ton per mile:—

Bodmin,	4·00*d.*
Maryport and Carlisle,	4·00
Whitby and Pickering,	4·00
Whitehaven,	3·10
Ballochney,	3·00
Wishaw and Coltness,	2·32
Lancashire and Yorkshire,	2·29
Arbroath and Forfar,	2·12
Norfolk,	1·25

The amount of grain and meal carried by railway is certainly not under a quarter of a million of tons, and most probably exceeds three hundred thousand tons.

Through the kindness of Mr. Waddington, I have been favored with the following return of grain, flour, and seed, carried for the London markets by the Eastern Counties Railway:—

Half-year ending	Flour. Sacks.	Malt. Qrs.	Wheat. Qrs.	Barley. Qrs.	Oats. Qrs.	Beans. Qrs.	Peas. Qrs.	Seed. Sacks.
June 26, 1847,	126,269	99,114	20,850	4,409	11,326	3,542	1,079	15,099
Dec. 25, 1847,	113,365	81,688	24,287	14,888	2,934	3,239	1,999	9,904
June 24, 1848, to	149,957	139,078	26,649	9,990	16,426	1,858	931	11,445
Aug. 12, 1848,	45,360	28,300	14,847	789	2,132	407	140	2,971

Not knowing the average weights of the above, they cannot be reduced into tons.

No. 18.—*Provision Traffic.* There are no means of estimating the provision traffic on railways, but such returns as there are show that it is very great.

The rates charged are as follows, per ton per mile:—

London and Brighton,	5·69*d.*
Preston and Wyre,	4·00
London and South Western,	2·57

Ale and beer are carried largely on the South Western, Newcastle and Carlisle, and other lines. The rates on the London and South Western are 2·09*d.* per ton per mile, and on the Durham and Sunderland, 2*d.*

To the tonnage of provisions must be added that of fish and grain, which gives the following returns for 1847:—

Fish.—Great North of England,	1,000	tons.
Norfolk,	12,000	"
Whitby and Pickering,	1,100	"
Grain.—Great North of England,	6,000	"
Slamannan,	2,600	"
Wishaw and Coltness,	1,300	"
Provisions.—Eastern Counties,	30,000	"
Lancashire and Yorkshire,	117,312	"
" Preston and Wyre,	5,220	"
London and Brighton,	3,632	"
London and South Western,	40,665	"
Norfolk,	25,000	"
South Eastern,	10,000	"

In 1845, I estimated the supply of provisions to the London markets by railways as follows, to which I subjoin a new estimate. This does not include cattle.

	Tons. 1845.	Tons. 1848.
South Eastern, - - -	7,000	10,000
Brighton, - - - -	5,000	30,000
South Western, - - -	20,000	20,000
Great Western, - - -	30,000	40,000
London and North Western, -	30,000	30,000
Eastern Counties, - - -	15,000	100,000

Among these articles are fresh fish, meat, milk, butter, fruit, &c., which cannot be brought from great distances except by railway. Milk is now largely carried on the Eastern Counties and other railways, under arrangements by which the companies take back the empty cans.

The metropolis is now the seat of a considerable trade in provisions, supplying to the country towns, fish, prime beef, poultry, fruits, and articles of foreign provision.

The whole provision traffic of each district, including fish and grain, may be estimated as under.

District.	Tons.
Northern, - - - -	100,000
North Western, - - -	200,000
Midland, - - - -	50,000
Western, - - - -	50,000
South Western, - - -	30,000
Southern, - - - -	50,000
Eastern, - - - -	200,000

This estimate does not include Scotland. It is very vague and much under the mark.

No. 19.—*Manure Traffic.* This traffic is of great value to the agricultural interests, but there is a want of adequate information respecting it.

The rates are as under, per ton per mile.

Newcastle and Carlisle, (guano) -	2·50*d.*
London and Brighton, - -	2·24
Arbroath and Forfar, - - -	2·12
Leicester and Swannington, -	2·00
Lancashire and Yorkshire, - -	1·33
Wishaw and Coltness, - -	1·10
York and North Midland, - -	1·00

Lime and sand are likewise carried as manures.

It is much to be regretted that no adequate measures are taken for applying the manure of towns. In the metropolis alone, the waste cannot be less than what would be equivalent to raising food for a million of people.

The following is an estimate of the whole amount of manures carried:

Lime, - - - - -	210,000 tons.
Sand, - - - - - -	30,000
Manure, - - - -	40,000

The whole quantity is, perhaps, about three hundred thousand tons, and it may be safely taken that there is a production of food for a hundred thousand individuals effected by means of railway transit.

Bones form a regular article of transit on some of the railways. The charge on the Arbroath and Forfar Railway is 2*d.* per ton per mile.

No. 20.—*Miscellaneous Agricultural Traffic.* Many small articles are included under the head of agricultural traffic, as to which there are a few scattered details in the returns.

On the South Eastern Railway hops are carried. This is a season traffic, carried on one-half year only. The number of tons in 1847 was 7248, and the receipts £7741.

The rate of charge on the London and Brighton is 2·5*d.* per ton per mile.

Malt is not carried so much by railway as might be expected, because the malt gets shaken up, and then measures less on delivery, because it cannot be so well heaped up. As the quality of the malt is not affected, this is only a temporary prejudice on the part of the dealers.

The charges for carrying malt are, on the London and South Western Railway, 3*d.* per ton per mile, and on the London and Brighton 2·68*d.*

Bark is carried on most of the Southern lines. The rates are, on the London and Brighton, 2·68*d.*, and on the London and South Western, 2·57*d.*

Brooms are manufactured near the London and South Western Railway, and are carried at the rate of 2·09*d.* per ton per mile.

Hay is reckoned hazardous, from its liability to catch fire from the engine sparks. The quantities carried and the amounts received on the Newcastle and Carlisle Railway are—

1846.	1847.	1846.	1847.
968 tons.	1003 tons.	£892	£879

The rate of carriage on the above railway is 5*d.* per ton per mile.

There are no details as to wool traffic, though wool of home and foreign growth is carried. The rate is 3*d.* per ton per mile.

There is a return of potatoes carried in 1846 on the Wishaw and Coltness Railway, 43 tons at 2·35*d.* per ton per mile, the receipts being £2 only.

The rates for hides are, on the London and South Western, 2·5*d.* per ton per mile, and on the London and Brighton, 3·5*d.*

Civ. Eng. & Arch. Jour., Nov. 1848.

To be continued.

Railway Bridges.

Upon the extension line of the Blackwall Railway, from Stepney to Bow, are two bridges, which are of a peculiar form, and the first of their class erected for railway purposes. The roadway upon them is supported on wrought iron girders, placed transversely between two arches or ribs formed entirely of wrought iron. The clear span of one is 120 feet, of the other 116 feet 8 inches. Each arch or rib of the latter bridge, which carries the railway over the Regent's Canal, is formed of a box built with iron boiler plates $\frac{1}{8}$ in. in thickness, and angle iron firmly riveted together, its breadth being 2 feet 10 inches, its depth about 2 feet, and sectional area 81 square inches, and is connected at the base by a wrought iron tie-bar, which receives the horizontal thrust of the arch, and is formed of links having a total sectional area of 69 square inches, bolted together with bolts $2\frac{3}{4}$ in. in diameter, aided by eight others at each joint, $\frac{3}{4}$ in. in diameter. Between the tie-bars and the arch a system of vertical and diagonal bracing has been introduced, so as in a manner to distribute the weight of passing loads equally over the whole arch. These ribs so formed are laid in cast iron plates, fixed at one end and free to move at the other over rollers, so as to allow scope for the expansion and contraction of the metal. The clear interval between the bearings is 116 feet 8 inches, and the rise of the arch is 8 feet to the underside of the box of which it is formed, the roadway being beneath the arch, and about 2 feet above the bottom of the tie-bar.

The structure is exceedingly light, but appears, nevertheless, sufficiently strong to carry the weights which may come upon it in practice, so far as the areas of the arch and bowstring, or tie, are concerned, and has stood the test of a dead weight of 240 tons, (in addition to its own weight of 59 tons,) distributed in weights of $34\frac{1}{2}$ tons at equal distances over its length, with a deflexion of $3\frac{1}{8}$ inches, and recovered entirely its original position upon the removal of the load. As this proof exceeds considerably any weight that can be brought upon it in practice, I am of opinion that it may be used with safety for the passage of trains; but as it is of so novel and light a construction, and the action of the cross-bracing and connexion of the tie-bars have not been ascertained by continued experiments of moving weights, I should recommend that it be examined from time to time, so that any defect, if it should exist, might be ascertained, more particularly as the weight of the whole bridge, including the double line of roadway and covering, only amounts to 194 tons, and is very easily set in vibratory motion by any moving power.—*Capt. Simmons's Railway Report.*

Lond. Min. Journ., No. 718.

Report upon the Use of Anthracite Coal in Locomotive Engines on the Reading Railroad, made to the President of the Reading Railroad Company, by GEORGE W. WHISTLER, JR., *April* 20, 1849.

(Continued from page 87.)

Conclusion.

In concluding this Report on the use of anthracite coal in locomotive engines, with reference to the present practice and prospective results upon the Reading Railroad, I would offer a few remarks touching the facts just recited, confident that these facts comprehend all that relates to mineral fuel in locomotive engines which is desired to be known by your company, and will establish the proportion of coal to wood consumed, and also the extra expense, in repairs of engines, consequent upon the use of this fuel.

The results of the observations upon the Reading Road have been given in detail, and the proportion of coal to wood consumed for equal amounts of work done, is shown to be 1 ton of anthracite coal in the Baltimore engines, to 1·8 cords of wood in the Reading built engines, 1·64 cords in the eight-wheeled Baldwin engines, and 1·37 cords in the engine Champlain, built also by Mr. Baldwin.

The apparent discrepancy in these results may be accounted for in the effect produced by cutting off the supply of steam to the cylinders of some of the engines after a portion of the stroke is made; which, in well proportioned engines, results in an economy of fuel. Of the engines under consideration, the Baltimore coal-burners and the Champlain are cut-off or full-stroke engines at pleasure, while the eight and six-wheeled wood engines are worked at full stroke only.

In making comparisons from the consumption of fuels, I shall endeavor to show, from the relative merits of these several engines, how coal may reasonably be expected to compare with wood, when all the engines are using fuel economically, taking the Champlain for the standard, as the best proportioned engine on the road for the adhesion she has to overcome, and as comparing favorably with like engines upon other railways in her consumption of fuel.

Engines.	Adhesion to overcome.	Size of cylinder.	Consumption of fuel.	Remarks.
Champlain, ...	20·0 tons.	16·0×18	10·25 Cords.	Cut-off.
Baltimore Coal Engines,	25·0 "	16·5×20	9·00 Tons.	"
Eight-wheeled Baldwin,	22·5 "	15·5×20	13·75 Cords.	Full stroke.
Six " "	19·5 "	15·0×18	13·00 "	"
Six " Reading,	20·2 "	14·5×20	13·62 "	"

The water evaporated by these amounts of fuel I am not able to state, except in the instance of the coal engines at 14,400 gallons, and the eight-wheeled wood engines at 16,200 gallons. This element for all the engines would, however, facilitate their comparison, though no strictly scientific investigation is aimed at, and none was contemplated at the time of making the observations.

It will be seen, by inspecting the above table, that the cylinder power of the Baltimore coal engines is less, for the adhesion they have to overcome, than the Champlain's; and therefore they require to be worked either on the full stroke, or, if on the cut-off, under a very high pressure of steam, which results, indirectly, in the greater consumption of fuel for work done. To understand this clearly, it must be borne in mind that the use of the cut-off on coal engines has a more important bearing on the economy of fuel than the same arrangement upon a wood-burning engine, and for these reasons: when the coal engines are worked upon the full stroke, the exhaust is very strong, and the draft through the fire proportionally increased; this soon produces an exceedingly hot fire, and every fresh supply of coals thrown upon it at once crumbles and compacts upon the grate, offering increased resistance to the passage of air through its mass, while less perfect combustion results, and much of the finer coal upon the surface is carried through the tubes and wasted. This "*cutting-up*" of the fire, as it is termed, will take place when necessity requires that the engine should be worked upon the full stroke, and for this reason the cut-off becomes indispensable to a good coal-burning engine.

The first effect produced by a change from the full stroke to the cut-off is that of lessening the draft through the fire by the moderated exhaust in the stack, evaporation then goes on more slowly in the boiler, and would reduce the pressure of steam necessary to working on the cut-off, were there no means of again increasing the intensity of the draft. The variable exhaust, however, furnishes this with facility, and evaporation again becomes rapid, though with much less disturbance to the fire. All these considerations were well understood at the time the Baltimore coal engines were being constructed, and the necessity for cylinders even of a greater diameter than 16·5 inches, in anticipation of an adhesion of only twenty-three tons, was urged by the builder, but not allowed by the engineer of your road. This restriction, together with the increased weight of the engine beyond that anticipated, has impaired the beneficial effects of the cut-off on the Baltimore coal engines to such an extent, that economy in the consumption of steam, and more quiet combustion of coal, is almost counteracted by the rapid evaporation required for the small cylinders. I would not be understood by this to controvert the received truth, that the same quantities of heat will evaporate equal quantities of water under all pressures; for so far as this question alone is considered, mere size of cylinders could have no effect in increasing or diminishing the quantity of fuel consumed; but for the practical difficulties just stated, and the fact that, for higher pressures, higher temperatures are required, and therefore radiation from all parts of the boiler must take place to a greater extent, a larger expenditure of fuel will result. To this loss there must also be added that caused by leakage, which is in direct proportion to the pressures; and when it is required to carry steam very high, self-preservation teaches men to keep the boiler blowing off all the time, as the only surety that steam is not made too fast.

When the Baltimore engines are worked on the full stroke, they make an abundance of steam with seven inches area of blast-pipe, though the effect upon the fire is to *cut it up*, as explained; but when working on the cut-off, the area of the blast-pipe requires to be so reduced, that much of

the ill effects on the full stroke are felt, and the resistance due to the blast-pipe is also greatly increased, for its area may be reduced to 2·25 inches. No better proof of the inadequacy of the cut-off alone, to ensure economy with the present size of cylinders, can be offered than the fact that, except where attention has been paid by the engine-man to the variable exhaust, the economy due to the cut-off has not resulted from its use.

During the early working of these engines on the Reading Road, it was with much difficulty that men could be induced to use the cut-off, and the engines were for some time worked on the full stroke, with a consumption of about 10·5 tons per round trip; now the cut-off is used entirely on all the engines, and yet, by referring to the observations made upon the Ohio, her consumption of fuel is not diminished; while, again, it is seen that the same engines have made trips over the road under the same circumstances with one-half this quantity of fuel.

Where so much depends upon men, it is almost impossible to say what may be accomplished with the engines as at present proportioned. The best results obtained with these engines show that one ton of coal is equal to two cords of wood in the Champlain, and the average every-day work upon the road shows that they compare with this engine as 1 to 1·37; this is allowing nine tons of coal to the round trip, a quantity, however, which they do not consume, for I should estimate that one ton of this is thrown or wasted from the tender, the floor of which is grated; coal, moreover, is so plentiful on the Reading Road that care is not taken to preserve, for stationary purposes, that which is not considered the best for locomotives; but, without regard to this waste, I am of opinion that the engines, as they are constructed, may be made to do their work every day, with a consumption of fuel which shall not exceed one ton of coal for 1·62 cords of wood in the best wood-burning engine on the road. With the other wood-burning engines, the coal-burners would compare more favorably, even should the cut off be applied to them. It is quite practicable to substitute cylinders 18 inches in diameter on the Baltimore coal engines, in place of the 16·5 inches, and then the consumption of coal to wood, in all probability, would bear that proportion which experience proves attainable, viz: one ton of anthracite coal to two cords of wood.

In reviewing all the facts touching the consumption of coal in locomotive engines, I would draw your attention, in conclusion, to the table of fuels consumed on the Baltimore and Ohio Railroad, from 1833 to 1848. By an examination of this table it will be seen what experience alone can do in reducing expenditures, for it will be easy to detect the same engine through a period of years, and see her progressive economy in the consumption of fuel. Time and experience alone have accomplished this, and much may be expected for the Reading Railroad when, by the more general use of anthracite coal, it shall be regarded less a matter for experiment than an important element of railway success, to be perfected with care and attention.

The subject of extra cost for repairs of coal over wood-burning engines has been investigated with care, and it will be unnecessary here to enlarge upon what has already been said; the statements in detail show what the extra cost has been for the Baltimore engines, and I propose now to offer

a few concluding remarks, suggested by past experience, upon the probable diminution in this expense.

Experience thus far proves that the copper fire-sheets are destroyed far more rapidly by the mechanical action of the particles of anthracite coal than by the intense local heat, and it becomes, therefore, a matter to be considered in renewing these sheets, whether copper may be made more secure against this unexpected deterioration, or whether it might not be well to resort again to iron; for if with care and means it can be made sound, it will not only be more economical in its first cost, but resisting as it does the mechanical action of the coal, will last a long time, and reduce the present cost for repairs to a very small amount.

The estimate which has been submitted of the actual cost of renewing the fire-place of the engine Baltimore is $378; if deduction be made for one-third less material in fire-place, (as explained,) this expense will be reduced to $345. The principal consideration, however, is, how frequently will these copper sheets require renewing?—the first copper fire-place has been destroyed after fourteen months' service over 23,845 miles of road, but experience has suggested improvements in renewing these sheets; additional stay-bolts have been put in the fire-box to prevent the copper, (which becomes very ductile by the intense local heat,) from being bulged out, and thus forming projections in the fire-place, readily acted upon by the particles of coal in motion. By this additional security to the Baltimore's copper fire-sheets, there is reason to believe that its fire-box will last two years, and I submit an estimate of the annual cost for repairs of these engines in accordance with this view.

Cost per annum for renewing fire-sheets 26 inches wide, after two years' service,	$172·50
Cost per annum for all other expenses, ...	207·00
Total cost per annum over wood-burning engines, ...	$379·50

Iron would undoubtedly be a better material for fire-sheets than copper, but the uncertainty attending its use has caused it to be discarded in coal engines upon roads of any length and business; this has been the case on the Baltimore and Ohio Railroad with the use of bituminous coal, though less destructive in its effects than anthracite. Iron-masters, however, have not been called upon for a quality of iron so superior as that required for the fire-places of coal engines; but when it is understood that such iron will command a ready sale and price, in proportion to its cost, I doubt not but it will be produced.

Whether copper or iron shall be the material used, experience shows that great advantage is gained by constructing the fire-boxes so that repairs and renewals of sheets, may be made with the least expense in time and materials; attention to this has resulted in producing coal engines of a later construction than those on the Reading Road, with their fire-places much simplified for this important consideration.

There are other parts of the fire-box liable to depreciation beside that part in the immediate vicinity of the coal fire, but they have not been referred to by me in the estimate for repairs just given, as experience had shown that such parts, (crown, side, and back sheets,) when more than twenty inches above the grate, had not required renewing, either on the Reading Road with the use of anthracite coal, or on the Baltimore and

Ohio Road with the use of bituminous coal; it was not, therefore, considered of sufficient importance to estimate in detail this possible extra expense, but it was believed that the above-mentioned sum of $379·50 would be found quite sufficient to cover all contingencies, even with the present early experience with coal engines; for when, after several years' working of an engine, it shall become necessary to renew these sheets, the cost per annum to cover this expense will be but small.

I have made no allowance for renewing the tube or flue sheet in the fire-box end of the boiler, as such extra expense is not necessarily entailed on coal-burning engines. Before sufficient experience had been had with coal engines, these tube sheets were put in too thin, and the distance between the tubes was so slight that the operation of caulking broke the head through from one tube to the other. I am aware that such difficulty is experienced with the Baltimore coal engines on the Reading Road, but the present mode of renewing such sheets will prevent this expense recurring sooner than with wood-burning engines.

In comparing the cost for repairs of fire-place, tubes, &c., in any engine on the Reading Railroad, with similar repairs of engines on other roads, the amount of fuel consumed in a given time is that which will determine their relative periods of duration. Now the Reading Road has great advantages over all other roads in this country, in the amount of work which can be done over it in a given time, for its grades are light and descending in the direction of the trade; and when the work of each engine on this road is compared with the work on an undulating road, such as the Baltimore and Ohio Road from Harper's Ferry to Cumberland, it will be found that the consumption of fuel is in proportion to the work done.

Road.	Measured distance per round trip.	Gross load per round trip.	Fuel consumed. Coal.
Reading, ...	190 miles.	900 tons.	9 tons Anthracite.
Baltimore and Ohio, . .	196 "	550 "	5 " Bituminous.

If the Baltimore and Ohio Road, (whose measured distance is about equal to the Reading Road,) had no grades exceeding the angle of repose; or, in other words, no grades which allowed a load to be propelled entirely by its gravitation, then the statement above would show the proportions of work done to coal consumed in running the same number of miles; but when the grades exceed this limit, (30 feet per mile, or 12·78 lbs. per ton for friction being taken as the angle of repose,) then all such distance must be equated in order to arrive at the whole work done. By referring to the description of the Baltimore and Ohio Railroad from Harper's Ferry to Cumberland, it will be seen that fourteen miles ascend, and ten miles descend, at a rate of thirty to forty feet per mile, thus making in the round trip twenty-four miles of this grade to be overcome, and the same distance to be moved through by the gravitation of the load. The ascending grade will be equal to about fifty-two miles of level road, and as steam is necessarily made and blown off in descending the twenty-four miles by gravity, it is estimated to be equal to taking the load over eight miles of level road; this will make sixty miles of equated distance in place of forty-eight of measured distance. The curvature of the Reading Railroad, and that por-

tion of the Baltimore and Ohio Road between Harper's Ferry and Cumberland, is about equal.

Road.	Equated distance per round trip.	Gross load per round trip.	Fuel consumed.	Proportion of coal consumed to work done.
Reading, . .	190 miles.	900 tons.	9 tons Anthr.	1·00
Baltimore and Ohio,	208 "	550 "	5 " Bitum.	0·82

It has been shown that the miles run during the past year by the coal engines on the Reading Road, and by engines of the same class on the Baltimore and Ohio, were about 17,000, but, by the above table, it will be seen that the work done in the same time is in the proportion of 1 R. to 0·66 B. & O., and the coal consumed to do this work, in the proportion of 1 R. to 0·56 B. & O., consequently the duration of fire-places, &c., will be in the proportion of 0·56 R. to 1 B. & O. Anthracite coal, I presume, will always be more destructive in its effects than bituminous; but how much more so can only be known by experience; this much only is known: that a copper fire-place of one of the Baltimore and Ohio engines (the first one) has been removed after three years' service, over 54,000 miles of road, and a copper fire-place of one of the Baltimore coal engines on the Reading Road (the first one) has been removed after fourteen months' service, over 23,845 miles of road, which shows their durability for equal quantities of coal consumed to have been as 1 R. to 1·24 B. & O.

When the difficulties attending the use of anthracite coal in locomotive engines are considered in connexion with the entire want of experience with this fuel, on a scale adequate to the necessities of the Reading Road, it will not be too much to say that the Baltimore engines have been entirely successful as coal burners; the term is but comparative, and assigns no limit to the success which I believe will follow well directed efforts to improve such details as passing experience shall show to be necessary to insure greater economy of fuel, or greater durability of parts.

For the Journal of the Franklin Institute.

Description of an Iron Arched Bridge of 133 *feet span, across the Canal on Section* 5 *of the Pennsylvania Central Railroad. By* Herman Haupt, Esq., *Civil Engineer.* (With a Plate.)

The chief peculiarity of this bridge consists in its *iron arch*, which is extended to a very considerable span, and furnishes a highly important practical test of the powers of resistance, both of the material itself and of the particular form in which it is employed. At the same time the application of the principle upon which the structure is erected has been made under circumstances which render it perfectly safe; for, in the event of the failure of the arch, the truss, without it, is more than sufficient to sustain the greatest load that can come upon the bridge.

The general arrangement of the truss is that of a Howe bridge, consisting of top and bottom chords of wood, with braces, counterbraces, and vertical rods. The braces are in pairs, and the arches pass between them. The

counterbraces rest upon the arches, and are adjusted by means of set screws above and below.

The arch is constructed of a centre rib of cast iron, 7 inches deep, with upper and lower horizontal flanches, 5 inches wide; two rolled iron plates are placed on the top, and two on the bottom of the cast rib, breaking joint with the rib and with each other, and secured by clamps at proper intervals. Below the chords are solid cast iron skew backs; and castings, of suitable form to connect with the skew back and receive the ends of the arch, are placed on the top of the lower chord.

Believing that the failure of cast iron bridges results generally from the inequality of pressure upon the joints, it was proposed to obviate this difficulty in the present case, by interposing plates of annealed copper between the ends of the segments, so that if the arch should rise or fall by expansion or contraction, the comparatively yielding quality of the interposed material would distribute the pressure, and prevent the fracture which might be produced if the joint should open, and the pressure be thrown upon the upper or lower corners of the castings.

This intention was defeated by circumstances which rendered it necessary to hasten the completion of the work. The ribs were raised without dressing the joints, and the copper plates were therefore rendered useless, the inequalities of surface being too great to admit of their being advantageously employed. Under these circumstances a substitute was used which gave more satisfaction than could have been obtained by an adherance to the original design, and was much more economical. The joints were separated to the distance of one-fourth of an inch, and filled with spelter poured into them in a melted state; this was very conveniently done by binding a piece of sheet iron around each joint, and covering it with clay. The material introduced being nearly as hard as the iron itself, and filling all the inequalities of the surface, rendered the connexion perfect.

The pieces of castings were made with inch holes near the ends, through which rods were passed horizontally to assist in raising them. To support them when raised to their proper positions, pieces of board were nailed vertically from the top to the bottom chord, on each side of the truss, and short rods were passed through the holes in the ends of the castings, and through auger holes in the boards. By this arrangement the segments were held securely, and no obstruction was offered to the attachment of the arch plates, which were added by clamping one end and springing them around the arch by a rope attached to the other.

The most important advantage that was expected to be derived from the peculiar arrangement exhibited in this structure, was the practical test of the power of resistance of a counterbraced iron arch on a large scale, under circumstances which would render its failure, under any possible contingency, unattended with risk.

It has been observed that counterbraces are placed above the arch, resting against it by means of adjusting or set screws. In addition to this, there is a vertical post of oak between each pair of suspension rods, also terminating in a set screw resting on the arch. It will be readily perceived that, by loosening the lower counterbrace screws, and by tightening those on the posts, the bridge will be raised upon the arch, and the latter will

then bear the whole weight both of the truss and its load. If the arch should prove unable to sustain this pressure, the truss would sink again to its original position and receive the weight.

The experiment thus far has been entirely successful, and shows that the counterbraced arch, which is the lightest and cheapest system possible, is perfectly reliable for spans of any magnitude; it is, in fact, a satisfactory test both of the principle and of the material.

The manner of adjusting the trusses, and the observations subsequently made, were as follows:—

1. All the lower counterbraces were unscrewed.
2. All the upper counterbraces were tightened, but not screwed hard
3. The levels were taken from a permanent level-mark at the foot of every suspension rod.
4. The set screws upon the posts were tightened by two men, with suitable wrenches, beginning at the middle and proceeding towards the ends; after once going over, the level was again taken, and the bridge found to be raised one-fourth of an inch. The same operation was repeated, and the rise found to be half an inch, which was sufficient to make it certain that the whole weight was upon the arch.
5. The upper counterbraces were examined and found to have become loosened; they were again screwed up; the main braces were loose;—all of which were necessary consequences of raising the truss upon the arch. The time at which these adjustments were made was about 11 o'clock, in July; the weather warm.
6. The bridge was again examined on the following morning; the weather was cool, and the contraction of the arch, from difference of temperature, had caused the posts and counterbraces to become loose, whilst the main braces were found to be in full action: in other words, by the contraction of the arch the weight was again thrown upon the truss.
7. The post and upper counterbrace screws were once more tightened, and as the heat of the day increased, the arch expanded and lifted the bridge to a greater height than on the preceding day.
8. While in this condition, the whole weight being upon the arch, the post and upper counterbrace screws tight, and the lower counterbrace screws loose, a locomotive was passed over the bridge, and observations made with a level and rod whilst it was running repeatedly backwards and forwards. The greatest variation from the level of repose was $\frac{1}{8}$ in. The arch rose slightly when the locomotive was upon the opposite side, and fell as much below its original position when it was on the same side as that upon which the observation was made. This was the effect anticipated; it was not to be supposed that the arch, in the condition it then was, would be perfectly rigid, as the lower counterbraces were all unscrewed, and the upper ones, as their resistance was not transmitted to the opposite extremities of the diagonals of the panels, could not act with full effect.
9. After an interval of several days, during which the arch and truss experienced no change, except that the lower counterbraces were screwed up, a 23-ton locomotive was passed several times over the bridge. No level was at hand with which to make observations instrumentally, but the eye could detect no motion in the arch; it appeared to be perfectly rigid

in every direction, and a subsequent careful examination could not detect the slightest opening or compression at the joints.

The observations made thus far have been sufficient to satisfy the writer of the correctness of his views in regard to the strength and rigidity of a counterbraced arch, and its applicability to spans of great extent. Upon this principle, an iron bridge can be constructed at less expense than is now sometimes incurred in the erection of wooden ones, and the durability, with proper care, is almost unlimited.

An iron arch constructed in a manner similar to the above, would be perhaps the cheapest and best support for an aqueduct. As the load in this case is always nearly constant and uniform, the curve of the arch should be a parabola.

No practical difficulty need result from expansion and contraction, particularly if iron tie-rods are not used for the lower chords. The counterbrace rods can be so proportioned and disposed as to compensate for changes in the arch and keep the tension constant.

AMERICAN PATENTS.

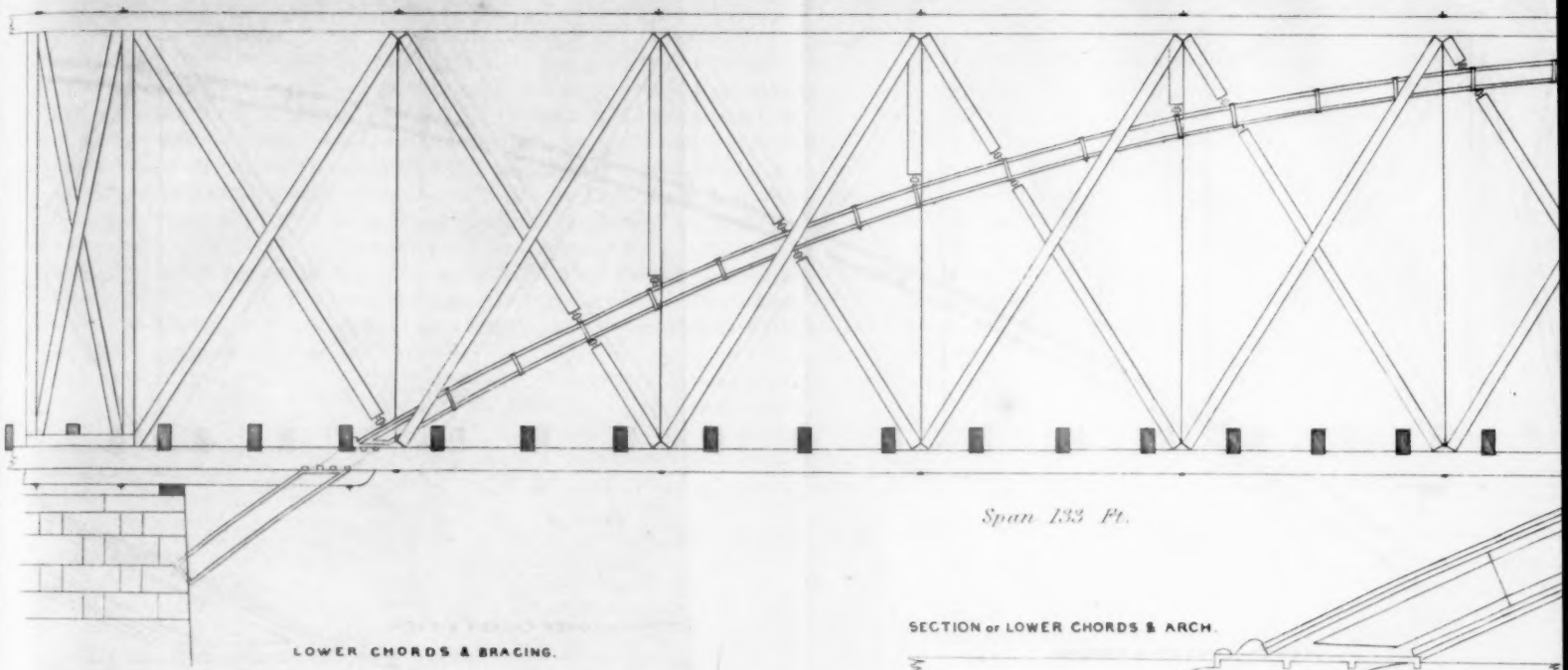
List of American Patents which issued in the month of November, 1848, *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in Machinery for Raising, Sawing, and Splitting Wood;* Cadet Crousillac, New Orleans, Jefferson county, Louisiana, November 7.

The patentee says,—"The nature of this invention consists in drawing the logs of wood found floating in rivers, or other logs, over horizontal rollers and under a gang of horizontal saws, at right angles to the same, attached to vertical stems, moving in mortises in a vibrating frame, and securing said logs by means of horizontal screws, jointed at their ends, and driven into the sides of the same, and sawing them into blocks of any desired length, and forcing the blocks or portions of the logs, after the screws are withdrawn from the same, forward on to an endless chain of parallel slats, by which they are conveyed and discharged on their ends under an iron weight moving vertically between slides and grooves, similar to the monkey of a pile-driver, and after inserting the sharpened edges of iron wedges in their upper ends, causing said weight to fall on said wedges, and split the blocks into pieces of the required size for fire wood; the machine being arranged together with a suitable frame, and operated by steam or other power."

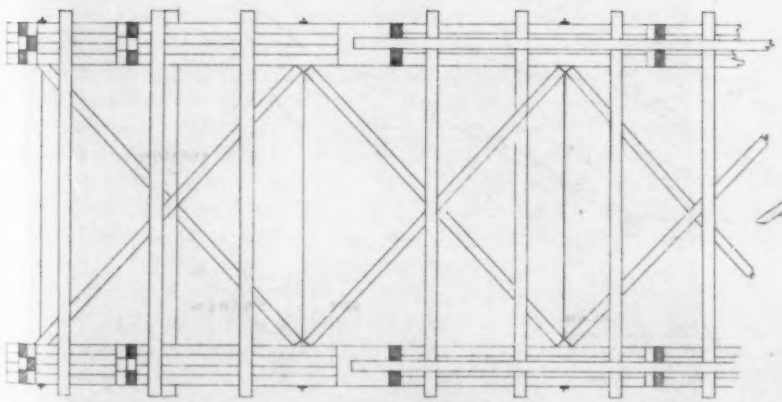
Claim.—"What I claim as my invention, is the combination and arrangement of the mechanism for raising, holding, and sawing large logs into short pieces, with the mechanism for conveying and splitting the said short pieces into fire wood; the whole constituting one machine, operated by the power of a steam engine applied to the main shaft, in the manner herein set forth."

CANAL BRIDGE SECTn 5 PENNa R. ROAD.

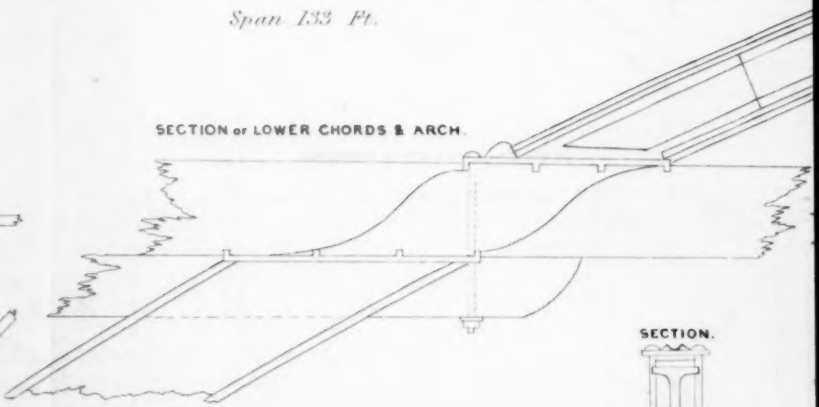


Span 133 Ft.

LOWER CHORDS & BRACING.

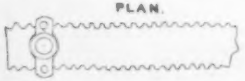


SECTION OF LOWER CHORDS & ARCH.



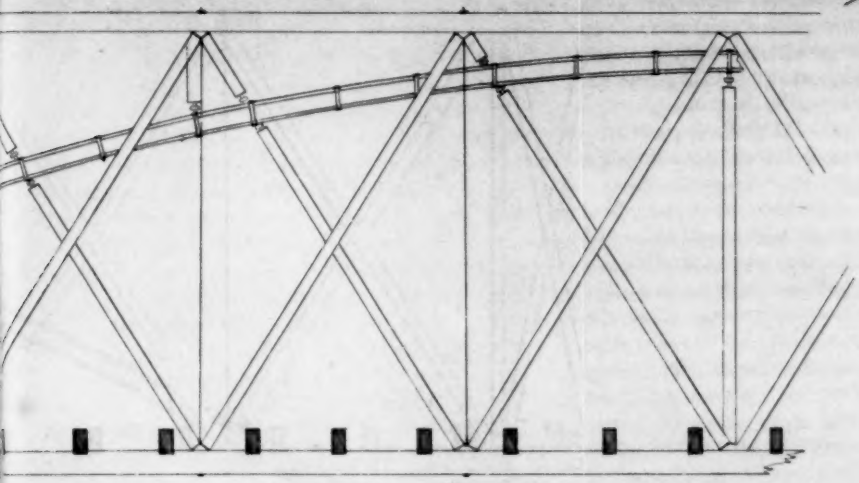
SECTION.

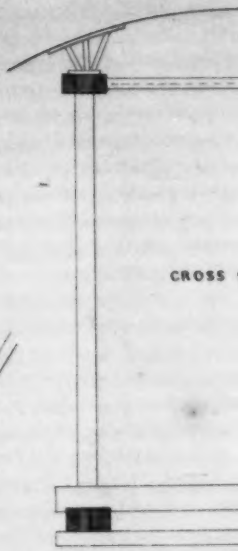
PLAN.



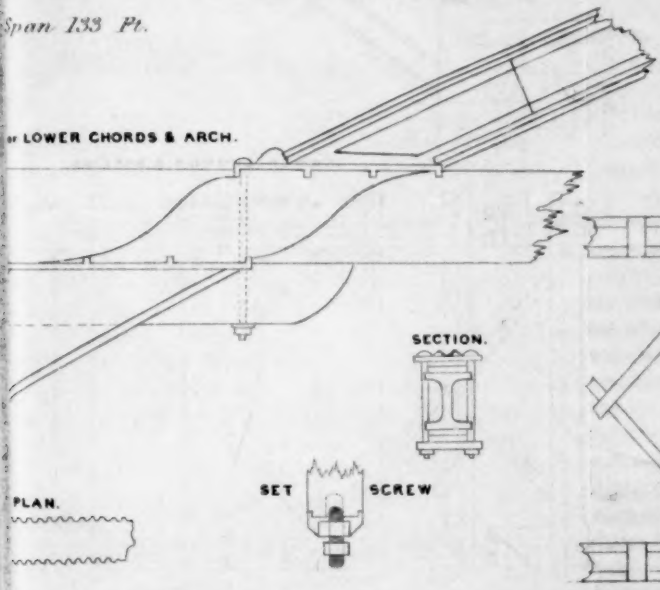
SET SCREW

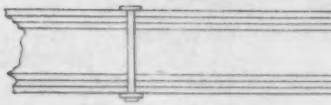
E SECTn 5 PENNa R. ROAD.

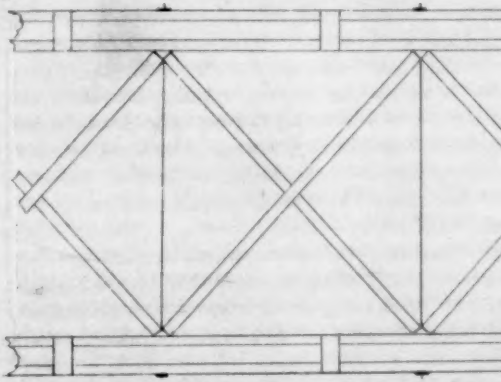




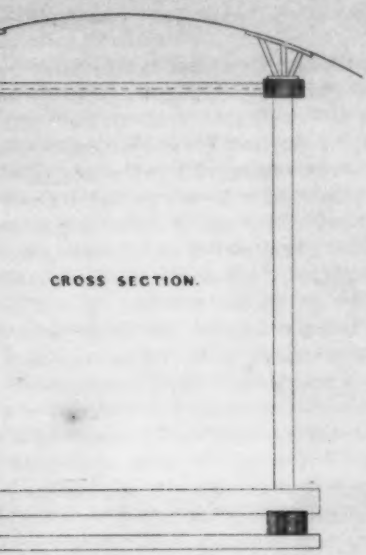
Span 133 Ft.





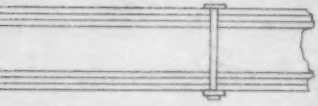


SCALE 8 FEET TO ONE INCH SCALE OF DETAILS

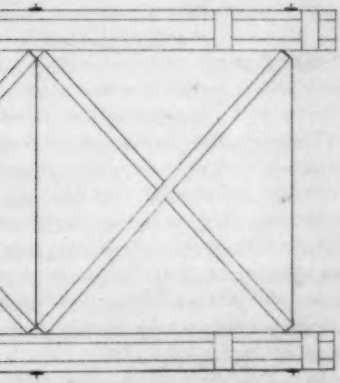


CROSS SECTION.

ATION or ARCH.



RACING



or DETAILS TWO FEET to ONE INCH

herein set forth."

2. For an *Improvement in Machines for Sharpening Instruments;* W. Z. & J. W. Chapman, Philadelphia, Pennsylvania, November 7.

The patentees say,—"The nature of our invention consists in a new combination and arrangement of known mechanical devices, whereby a rectangular grinding block, having a plain or fluted surface, is caused to move backwards or forwards under an adjustive turning holder, in which the various articles to be ground are held upon the face of the said block with ease and accuracy; also in securing over the ends of the grindstone adjustable bent metallic guards, to keep the articles being ground from slipping over the ends of the stone, and prevent the oil or water from flying off by its momentum at the time the motion of the stone is changed, and likewise to keep the oil or water supplied in sufficient quantity, and evenly spread over the surface of the stone, by means of the sponge or other absorptive substance secured upon their inner ends; and in combining with the reciprocating stone a flat revolving stone, which has likewise a turning adjustive rest connected with it."

Claim.—"What we claim as our invention, is the combination and arrangement of the adjustive turning holder with the grindstone, by means of which the apparatus is adapted to the accurate grinding of all manner of edged instruments. We also claim the combination of the vibrating clamp and turning holder with the adjustive sliding head, in the manner and for the purpose set forth. We also claim the combination of the grinding block with the guards, having sponges to be saturated with water or oil secured to their under ends, substantially in the manner and for the purpose set forth."

---

3. For an *Improvement in the Composition of Slate Pencils;* Lewis J. Cohen, City of New York, November 7.

Claim.—"What I claim as my invention, is the mixing or combining, in certain proportions, the materials of alumina, (in any of its forms,) with French chalk, or with soap stone, in combination with water, for making of a clay or mass for making white slate pencils, and the process of making the same, as set forth."

---

4. For an *Improvement in Suspender and Shoulder Braces;* H. Day and F. D. Hayward, City of New York, November 7; (ante-dated May 7.)

The patentees say,—"The nature of our invention consists in giving the required degree of elasticity to suspenders, shoulder braces, and other similar articles, by the use of an elastic ring, to which is attached the buckle and button leathers by means of a loop, which will slide along the ring nearest to the point of draught, whereby we are enabled to have an elastic spring in any required direction, with equal advantage in each."

Claim.—"What we claim as our invention, is the forming and rendering elastic suspenders, shoulder braces, riding belts, and other similar articles, by the use, in combination therewith, of the elastic rings, for the purpose of giving spring and draught, substantially as set forth."

5. For an *Improvement in Extension Tables;* George Pratt, Boston, Suffolk county, Massachusetts, November 7.

Claim.—"What I claim as my invention, is the combination of two or more sets of parallel bars, the machinery for extending and contracting the slide bars thereof, or moving them outwards and inwards, and the latching or unlatching contrivances, substantially as set forth. I also claim the said latching and unlatching contrivances, as constructed and applied to their slide bars, and operating (when they are moved by mechanism substantially as set forth) to connect or disconnect them, in manner as set forth. I also claim the manner of adapting the crank of the pinion shaft to said shaft, so that said crank may be moved or drawn outwards, and forced inwards, and turned upwards into a socket, and be made to clutch or engage with, and be disengaged from, the shaft, as occasion may require."

---

6. For an *Improvement in Machinery for Stamping and Cutting Crackers;* Cyrus Baldwin;—assigned to J. & E. Baldwin, Goffstown, Hillsboro' county, New Hampshire, November 7.

Claim.—"I claim the combination of an air-tight cylinder and piston with each of the cutters, so as to operate in the manner set forth, and, by means of suction or the pressure of the atmosphere, raise the cracker or biscuit out of the dough or scraps, and prevent it from dropping out of the cutter while the latter is being elevated, as set forth; meaning to claim, in connexion with each cutter, an apparatus to create atmospheric pressure on the biscuit or cracker, substantially as set forth. I also claim the combination of the series of cutters or cutting mechanism and the two endless aprons, as made to operate together substantially as set forth. I also claim the revolvable flour duster, as combined with the endless apron, and used substantially as set forth."

---

7. For an *Improvement in Filling Barrels with Flour;* B. Bowman and A. Kauffman, Orrstown, Franklin county, Pennsylvania, November 7.

Claim.—"What we claim as our invention, is a new and useful method of filling flour into barrels in a mill, and weighing the flour and barrel together by one process, by means of a movable trough suspended on axle points near the centre of its sides, giving a preponderance to that division of it that is farthest from the barrel, and a pair of platform scales fixed below the light end of the trough, upon one end of which scales the empty barrel is placed to receive the flour from the trough, and on the other end the weights are placed, with the end of a lever mortised on it also, which, rising with that end of the scales when the barrel has reached its weight, unloops or unhooks a rod or wire from a pin in the frame-work above, that stayed at rest an inclination towards the barrel while it was filling, and thus permits the trough, by its unequal balance, to reverse its inclination, and convey the surplus flour into a chest on the opposite side to receive it."

---

8. For an *Improvement in the Manufacture of Elastic Cloth;* Richard Solis, City of New York, November 7.

Claim.—"What I claim as my invention, is the mode of preparing the

cloth for the rubber, by stretching it in the manner set forth; and also the placing the rubber on the cloth obliquely, as set forth."

---

9. For an *Improvement in Side Hill Ploughs;* Hayward Cox, Peach Bottom P. O., Grayson county, Virginia, November 7.

The patentee says,—"This improvement consists in securing a double mould board plough to the forward and back part of the land bar, at its lower part, and to an inclined rod extending from near the point of the land bar to the beam, at its upper forward part, in such a manner that the back and upper parts of said plough can be thrown on either side and secured there, in order to form a right or left hand plough, to throw the furrow either way, or can be secured immediately below the beam, to form a cultivator plough."

Claim,—"What I claim as my invention, is the employment of a horizontal plate, perforated with an opening made in the form of the letter E, and fixed to the head of the standard, in combination with the perforated triangular plate and curved dog or lever, and inclined rod, on which the double mould board and land side turns, by which the plough is alternately changed from a right to a left hand plough, for ploughing on the sides of hills, and also for converting it into a cultivator, for ploughing between potatoes, corn, &c., as set forth."

---

10. For an *Improvement in the Duck Foot Propeller;* George Seibert, Hagerstown, Washington county, Maryland, November 7.

Claim.—"What I claim as my invention, is the opening and closing of the wings of a propeller, by means of the combination of a sliding rod furnished with racks, or with the reciprocating bar, and also with arms having pinion segments, and being connected through the arms with the wings of a propeller when not required to be reversed, as set forth. I also claim, in combination with the reciprocating bar to which are attached springs, the projections on the wings of a propeller, when said springs are employed to deaden the shock which would otherwise be felt on using said wings, in the manner set forth; not claiming the general plan of using springs to arrest motion or prevent shocks. I also claim, in combination, the reciprocating bar, springs, projections, wings, arms, toothed segments, sliding rod, projections, and slot, constructed and acting substantially as set forth."

---

11. For an *Improvement in Tubes for Raising Lamp Wicks;* R. C. Overton, City of New York, November 7.

Claim.—"What I claim as my invention, is the manner of constructing the wick tubes so as to raise and lower the wicks conveniently, the same consisting of the concentric tubes, the slot in the outer tube, and the pin attached to the inner tube, working through the slot."

---

12. For an *Improvement in the Screw Jack;* F. Ellis and B. S. Buckley, Roxbury, Norfolk county, Massachusetts, November 14.

Claim.—"We claim, in combination with the two ratchet wheels and

lever apparatus for rotating them and their shaft, the two sets of screw mechanism extending from the shaft on which they are placed, the whole being constructed and made to operate substantially as set forth; not meaning to claim a simple duplication of a screw jack and lever apparatus, but meaning to claim the combination of the two jacks, or the double jack with but one lever apparatus, as set forth. We also claim the particular manner in which we construct the key lever, the frame, and dogged piece, so as to operate together: that is to say, the said key lever being made with a notch, and the said frame being made with a hole through its end piece, to receive said lever, and allow it and the dog piece to operate, and the other parts being constructed and applied together as set forth."

---

13. For an *Improvement in Odometers;* William Oldroyd, Mount Vernon, Knox county, Ohio, November 14.

Claim.—"What I claim as my invention, is the combination of the circular inclined plane, attached to the hub of a carriage wheel, with the piston, click, and spring, for turning the cog wheels, pinions, and index, in the manner and for the purpose set forth."

---

14. For an *Improvement in the Manufacture of Buckwheat Size;* William A. Comstock, Providence, Rhode Island, November 14.

Claim.—"What I claim as my invention, is the making of sizing for yarns from buckwheat meal, substantially in the manner or by the process set forth, the same enabling me, at about one-third the usual expense of preparing wheat flour size, to produce a much better and more substantial size, one more especially adapted for fine yarns or difficult weaving than any heretofore in use."

---

15. For an *Improvement in Mills for Breaking and Grinding;* William Beal, Jr., Lowell, Middlesex county, Massachusetts, November 14.

Claim.—"What I claim as my invention, is the combined and simultaneous action of the teeth of the small cylinder, having a slow motion, with a series of stationary teeth, and with the teeth of the large cylinder, running at a high speed, substantially as set forth."

---

16. For an *Improvement in Furnaces for Steam Boilers, &c.;* F. X. Wurm, Vienna, Austria, November 14.

Claim.—"What I claim as my invention, is the manner set forth of employing steam and heated air together, the same consisting substantially of the combination of the steam pipes, tuyeres, and close chamber or ash pit. And I also claim the employment of the two sets of tuyeres, for introducing steam and heated air in the manner set forth: that is to say, one being applied at the grate bars while the other is applied to the combustion pit, for the purposes substantially set forth."

17. For an *Improvement in Operating Brakes for Railway Cars;* C. B. Turner, Buffalo, Erie county, New York, November 14.

The patentee says,—"The nature of my invention consists in a certain new and useful combination of horizontal transverse turning shafts and pendant levers to them, to which are secured horizontal transverse bars, having concave rubbers to press against the peripheries of the car wheels, and intermediate suspended levers, with similar transverse bars and concave rubbers, and for the like purpose to those first mentioned, placed against the opposite sides of the wheels, the said pendant and suspended levers being connected by parallel longitudinal jointed screw rods and nuts, the upper end of the intermediate suspended levers being connected by transverse timbers, the several series of rubbers attached to each car being actuated simultaneously by the momentum of the car, and a corresponding resistance of the contiguous car, by acting against the sliding bumpers, springs, and bars, which, in turn, act against the horizontal transverse timbers that connect the upper ends of the intermediate suspended levers, by which the concave rubbers are made to clasp the wheels in pairs, and thus to arrest the motion of the car gradually, and without producing a sudden and violent shock, a similar operation being produced on the several cars of the train in quick succession, there being two series of rubbers and bumpers to each car, operated simultaneously; said brakes being so arranged and combined with windlasses on the platforms of the cars, by means of levers and connecting rods, and chains, that the rubbers can be brought in contact with the wheels thoughout the train simultaneously, by the brakeman simply turning one of the windlasses."

Claim.—"What I claim as my invention, is, 1st, Constructing the brake so as to act simultaneously on all the wheels of the car or cars of the train, on opposite sides, by the momentum and resistance of the several cars, and the consequent contact of the bumpers, which actuate the rubbers, and by which the motion of the cars is arrested: that is to say, I claim the combinations of the rubbers, levers, shafts, bars, and rods, arranged and operated in the manner set forth, or operated by manual power applied through the agency of the windlasses, chains, levers, rods, or other similar contrivances.

"2d, I claim the manner of constructing the sliding spring bumper, for operating the brake by the momentum and resistance of the cars, as set forth: that is to say, I claim the combination of the slide with the bumper and spring, constructed, arranged and operating in the manner set forth."

---

18. For an *Improvement in Rotary Valve Musical Instruments;* Thomas D. Paine, Smithfield, Providence county, Rhode Island, November 14.

The patentee says,—"My improvement consists in the introduction and application of a third or centre valve pipe through the roller of the instrument, which said pipe may be round or oval."

Claim.—"What I claim as my invention, is the introduction, use and application of the third or centre valve pipe, through the roller or rollers of all rotary valved metallic wind instruments, the whole being combined and operating as set forth."

19. For an *Improvement in Coffins;* Almond D. Fisk, City of New York, November 14.

Claim.—"What I claim as new, is the manufacturing of coffins of cast or raised metal, when made substantially in the form set forth: that is to say, corresponding nearly to the human form; and, in combination therewith, the making of the coffin in two nearly equal parts, united horizontally by the flanch, as set forth."

---

20. For an *Improvement in the Roller Cotton Gin;* John Schley, Columbus, Muscogee county, Georgia, November 14.

Claim.—"What I claim as my invention, is the combination of the ginning rollers and shell with the tooth feeders, constructed and operating substantially as set forth."

---

21. For an *Improvement in Side Hill Ploughs;* Iram Brewster, Stamford, Delaware county, New York, November 14.

The patentee says,—"The nature of my invention consists is having a hollow mould board, to enable the plough to be easily shifted from side to side in ploughing ridges of land without making a long head land turn. For this purpose the mould board of my plough, being very light in proportion to its size, can easily be shifted from one side of the beam to the other side, by means of the spiral spring and the pivots revolving in the sockets."

Claim.—"What I claim as my invention, is, 1st, the hollow mould board and its combination with the standard and the spiral spring, substantially as set forth. I also claim the combination of the hollow plough point with the mould board as set forth, so as to make the upper and lower sides of the mould board alike."

---

22. For an *Improvement in the Machine for Plaiting Shirts, &c.;* Welcome Whitaker, Troy, Rensselaer county, New York, November 14.

The patentee says,—"The nature of my invention consists in providing two metallic plates, placed in a parallel position, attached to slides, and moving by levers on ways, and so regulated by stops and adjusting and set screws, as to let the folders alternately pass above each other, to the desired distance to give the proper widths to the plaits, or leaving alternately wide spaces to suit the pattern."

Claim.—"What I claim as my invention, is a single pair of folders, together with the stops, and adjusting and set screws, and the several appendages pertaining thereto, necessary to the convenient, parallel, and diversified action of the folders. I also claim the fixtures by which the cloth is suspended and delivered out during the operation of plaiting, as set forth."

---

23. For an *Improvement in Book Safes;* James P. Gage, City of New York, November 14.

The patentee says,—"The nature of my invention consists in the introduction of a book safe, principally intended as a fixture in the pews of churches."

Claim.—"What I claim as my invention, is the spring and ledge, combined with the inverted casing, to be used and constructed as set forth."

---

24. For an *Improvement in Harvesting Machines;* Francis S. Pease, Buffalo, Erie county, New York, November 14.

Claim.—"What I claim, is the combination of the levers, connecting rod, and spring, with the double platform and rake, for the purpose of alternating and turning the latter, as set forth. I do not claim to be the inventor of a tight case for the back of the blade to run in, nor of slotted teeth to protect its edge; but what I do claim, is making a toothed blade case in uniform sections, each section having a tooth cast in one piece with it, the whole being attached to the rack bar, by screws or otherwise, in such a manner that, if the tooth or case of any section should get broken, it may readily be replaced by an extra one, cast from the same pattern and kept on hand for that purpose, the rack thus made being equally efficient to protect the stock from dirt and obstructions with the solid case, and capable of being more easily and cheaply repaired. I also claim the manner in which the position of the point of draught is changed, by means of the slides and clamp screws, as set forth."

---

25. For an *Improvement in Filter Stop Cocks;* A. & H. Johnson, City of New York, November 14.

Claim.—"What we claim as our invention, is a filtering apparatus having two water chambers, one above and the other below, the filtering diaphragm is the central pipe with four passages, arranged substantially as set forth, in combination with the two-way cock, the passages of which are arranged substantially as set forth, for the purpose of drawing filtered or unfiltered water, and reversing the direction of the current through the filtering medium, for the cleansing thereof, as set forth."

---

26. For an *Improvement in Planing Irregular Forms;* A. Goodman and William Gibbs, Dana, Worcester county, Massachusetts, November 21.

The patentees say,—"The nature of our invention consists in forming cams or revolving guides, to govern a revolving cutter mounted in a swing frame, whereby wood may be planed of a great variety of shapes, in a smooth and regular manner."

Claim.—"What we claim as our invention, is the combination of the vibrating cutter frame with the cams, the jointed ratch, and adjustable straight or curved inclined plane, for the purpose of planing irregular spiral sided forms."

---

27. For an *Improvement in the Self-Feeding Machine for Charging Percussion Caps;* Marvin W. Fisher, Washington City, D. C., November 21.

Claim.—"What I claim as new, is, 1st, the manner of conducting the caps from the hopper, and depositing them in the apertures in the wheel, by means of the vibrating inclined groove, the rotating brush wheel, the feeding hand on the arm, the feeding finger connected to the arm, respec-

tively constructed, arranged, and operating with each other, and with the scolloped edged wheels, the vibrating levers, the cams, the weights, the cords, the vibrating vertical lever with its arms, the vibrating horizontal lever, and the ratchet, combined in the manner substantially as set forth.

"2d, I claim the combination of the cam on the main shaft, the vibrating lever, the charger, and the ratchet, with each other, and with the tube, the magazine, and wheel, for the purpose of rotating the wheel, and depositing a charge of fulminating powder in each cap placed in the wheel, substantially as set forth.

"3d, I claim the combination of the rotating brush wheel with the main shaft, and with the wheel, for the purpose of removing any fulminating powder that may be scattered by the charger upon the flanches of the caps and the face of the wheel.

"4th, I claim making the shaft or shank of the punch elastic, substantially in the manner and for the purpose set forth.

"5th, I claim the combination of the punch shank, the guiding and supporting tube, the pinion on the tube, the cog wheel and cam on the main shaft, with each other, and with the ring and spring encircling the lower end of R, for the purpose of imparting a rotary movement to the punch, pressing the same for a suitable length of time upon the fulminating mixture in a cap, and then elevating and retaining the punch while the wheel is moved, substantially by the arrangement and in the manner set forth.

"6th, I claim the manner of preventing the caps from turning in the apertures in the wheel, while they are being operated upon by the punch, and also preventing the caps from being drawn out of their apertures in the wheel by the punch, by means of the retaining arm at the lower end of the vertical rod, enclosed by a helical spring, and operated upon by the cam on the main shaft, substantially in the manner set forth.

"7th, I claim the manner of throwing the caps, when charged, out of the apertures in the wheel, into a proper receptacle, by means of the cam wheel on the main shaft, the rod, lever, punch, spring, and guiding spring, combined and operating with each other, and with the open sided funnel, substantially as set forth."

---

28. For an *Improvement in Dividers or Measuring Compasses;* Chas. Reiffel and N. Thorn, City of New York, November 21.

Claim.—"What we claim as our invention, is the two pivot plugs, constructed and adjusted as set forth.

---

29. For an *Improvement in Scythe Fastenings;* Oliver Clark, Brunswick, Medina county, Ohio, November 21.

Claim.—"What I claim as my invention, is fastening the scythe to the snath by means of two projections arising from the metallic plate, one of which being movable; they are made to grasp the scythe's shank in such a manner as to confine it firmly between them and upon the plate, attaching it to a snath of any approved form or construction, substantially as set forth."

30. For an *Improvement in Grass Cutting Machines;* William Boone, New Hope, Lincoln county, Missouri, November 21.

Claim.—"What I claim as my invention, is the combination and arrangement of the hinged scythe and radial boxes, as constructed and operated with the vertical pendant axle, and gearing to propel the same; said scythes being so constructed and arranged as to form nearly a circular cutting edge, while each segment of the cutter forms, by itself, a hinged segmental scythe, that can be raised or disengaged from the radial box at pleasure with very little inconvenience for grinding the edge, or for any other purpose, and be again restored to its place, the cutting being performed on the convex edge of the scythe, instead of the concave edge, as with the ordinary scythe.

"2d, I claim the manner of sustaining and supporting the pendant revolving axle, by means of the extended cap of the frame, in combination with the extended axletree, as set forth."

---

31. For an *Improvement in Couplings for Axles and Bolsters;* David W. Seeley, assignee of George Brown, Carlisle, Schoharie county, New York, November 21.

The patentee says,—"The nature of my invention consists in providing a better means of connecting the fore wheels of a carriage or other vehicle to its body, than the common ring bolts and connexions."

Claim.—"What I claim as my invention, is the combination of the body plate, the axle plate, and the ring bolt, constructed and connected to the body, the axle, and each other, as set forth, for the purpose of making a safe connexion of the fore axle with the body of the vehicle, or its perch or other contrivance, by means of the two metallic plates and bolt, as set forth."

---

32. For an *Improvement in Harvesters;* Uriah H. Goble and Alexander Stuart, Urbana, Champaigne county, Ohio, November 21.

Claim.—"What we claim as our invention, is, 1st, the combination and arrangement by which we cause the rotating rake to pass horizontally across the platform, to wit: securing the rake to the shaft in such a manner that it can slide freely to and from the same; placing rollers upon the projecting ends of the bar, (parallel with the rake head,) operating with the horizontal ways secured to the inner sides of the vertical ends of the platform, substantially as set forth.

"2d, We claim the imparting an unequal motion to the rake as it revolves, for the purpose set forth, by means of the eccentric pinion matching with the elliptical toothed wheel, substantially as set forth.

"3d, We claim, also, the imparting to the rotating rake a horizontal movement from the front to the rear edge of the platform, combined with a gradually diminishing rate of speed, substantially in the manner and for the purpose set forth."

---

33. For an *Improvement in Harvesting Machines;* Daniel Cushing, Aurora, Kane county, Illinois, November 21.

Claim.—"What I claim as my invention, is, 1st, the making the vibra-

ting cutters sickle-edged, moved in the manner and for the purpose set forth.

"2d, I claim the manner of combining and arranging the double cranks and axles of the rakes, so as to cause them to turn together, and at the same time to turn the two endless rakes, as set forth.

"3d, I claim the particular arrangement of the transverse endless revolving rakes, in combination with the other rake for delivering the cut grain upon the platform, as set forth."

---

34. For an *Improvement in Axle Boxes;* John Lightner, Roxbury, Norfolk county, Massachusetts, November 21.

The patentee says,—"The nature of my invention consists, 1st, in applying to, or combining with, the box and axle a stuffing box, so disposed as to effectually prevent the admission of dirt or dust into the box, or between it and the axle; 2d, in so constructing the composition bearing of the box and other parts connected with it, as to readily admit of the removal of said bearing at any time after it may have become heated or injured."

Claim.—"What I claim as my invention, is the movable plate and aperture made through the front of the box, in combination with one another, and the composition bearing and enclosing case, and made to operate substantially as set forth."

---

35. For an *Improvement in Cider Mills;* Nathan Chapin, Cortlandtville, Cortlandt county, New York, November 21.

The patentee says,—"The nature of my invention consists in causing the pummice to be subjected to the action of an additional set of crushing cylinders, arranged in an oblong box, having a perforated plate on its bottom through which the cider descends, for thoroughly extracting the cider from the same, and thus dispensing with the use of the ordinary press employed for that purpose, and combining with the box containing the crushing cylinders, a strainer or filter for separating the cider from the pummice and other impurities."

Claim.—"What I claim as my invention, is, 1st, subjecting the pummice to the crushing operation of an additional set of crushing cylinders, geared to, and meshing with, those that first receive and crush the apples, said additional cogged cylinders acting as dischargers, for discharging the pummice after the cider has been extracted, through openings in the sides of the box containing the crushing cylinders, whilst the cider is caused to descend through a perforated plate and the bottom of the box, into a receiver placed below the same, the aforesaid arrangement and use of said crushing cylinders and perforated plate enabling the farmer to dispense with the ordinary press, the crushing, pressing, and separating operations being performed substantially in this machine."

---

36. For an *Improvement in the Jacquard Machine;* Henry Kelley, Manayunk, Philadelphia county, Pennsylvania, November 28.

Claim.—"What I claim as my invention, is the combination, application, and use of the round cylinder, with pins or screws in its surface, and

cogged wheel on its end, (to operate in lieu of the four-sided cylinder or axis and its four-cogged wheel, and of the said cards,) together with the combination, application, and use of the said two pairs of racks, with a pinion working in and between the racks of each pair, all combined, applied, used, and adapted to the jacquard machine, as set forth."

---

37. For an *Improvement in Razor Straps;* Charles L. Fowle, Boston, Suffolk county, Massachusetts, November 28.

Claim.—"What I claim as new, is a combination made up of the following elements or their mechanical equivalents, viz. the double concave piece, the screw block, the screw, and the endless band, the whole being applied together and used as set forth."

---

38. For an *Improvement in the Jacquard;* William H. Greene, Jr., Schenectady, Schenectady county, New York, November 28.

Claim.—"What I claim as my invention, is the manner in which I have constructed the three trap boards: or in other words, the peculiar manner of arranging the saw splits and holes of the middle and two adjacent trap boards, whereby they may be used in connexion with the series of wires, each of which is constructed with the three eyes."

---

39. For an *Improvement in the Manufacture of Potatoe Starch;* E. M., J. S. & W. H. Gordon, Woodstock, Grafton county, New Hampshire, November 28.

Claim.—"What we claim as our invention, is the distributing trough, as combined with the subsiding vat, in the manner set forth. We also claim using a shallow subsiding vat, in the manner and for the purpose substantially as set forth, instead of using a deep one, as heretofore."

---

40. For an *Improvement in Knife Polishers;* Reuben Shaler, Madison, New Haven county, Connecticut, November 28.

Claim.—"What I claim is the apparatus as set forth, for supplying the inward surfaces of leather with the scouring or polishing material used for that purpose, the operation and construction being substantially as set forth."

---

41. For an *Improvement in Sewing Machines;* John A. Bradshaw, Lowell, Middlesex county, Massachusetts, November 28.

Claim.—"What I claim as my invention, is 1st, the combination of the rubber or friction plate, helical spring, and bobbin, with the case, as set forth, for producing the required degree of tension in the thread whilst being unwound from the bobbin, substantially as set forth.

"2d, I likewise claim the peculiar construction of the flying bobbin case, carrying the second thread, as set forth."

42. For an *Improvement in Cooking Stoves;* Leonard B. Field, West Sparta, Livingston county, New York, November 28.

Claim.—"What I claim as my invention, is the location of the oven by the side of the fire chamber of the flue space, past the rear end, and along the side of the oven to the smoke pipe, substantially in the manner and for the purpose set forth."

---

43. For an *Improvement in Mills for Grinding;* David Paddock, Pontiac, Oakland county, Michigan, November 28.

The patentee says,—"The nature of my invention consists in providing the runner or upper stone with funnels and tubes, so constructed and arranged as to gather and force between the bed stone and the runner currents of cool air, by the motion of the runner in grinding."

Claim.—"What I claim as my invention, is the concentrating and throwing between mill stones currents of cool air, by means of the action of the runner or upper stone, and funnels and tubes affixed to, or inserted in, the stone."

---

44. For an *Improvement in Sausage Stuffers;* Seneca S. Jones, Leicester, Livingston county, New York, November 28.

Claim.—"What I claim as my invention, is the construction and application of the grooves or other similar passages, to form ventilators or air escapes from the case, as set forth."

---

45. For an *Improvement in Machinery for Making Wooden Pegs;* Henry P. Westcott, Seneca Falls, Seneca county, New York, November 28.

The patentee says,—"The nature of my invention consists in providing cutters or punches, used in making wooden pins, with sockets so arranged as to point the pins at the same time that they are cut, and dislodge them from the machine."

Claim.—"What I claim as my invention, is the combination of pointing sockets, as set forth, with cutting punches, (used in making wooden pins,) in such a manner that they will point the pins at the same time that they are forced through the punches, and afterward dislodge them from the machine, the whole constructed and operating substantially as set forth."

List of American Patents which issued in the month of December, 1848, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Composition for the Pastel Vat, to be used in Dyeing;* Horatio N. Barrow, East Windsor, Hartford county, Connecticut, December 5.

Claim.—"I claim the composition or vegetable preparation of carrot or parsnip sprouts, made substantially as set forth, and used for the purpose mentioned."

2. For an *Improvement in Grinding Card Teeth;* George Emerson, Dyersville, Providence county, Rhode Island, December 5.

Claim.—"What I claim as my invention, is the combination of the sun and planet gearing, consisting of four cog wheels, with the hollow shaft, double threaded screw, and crescent-shaped piece of iron, by means of which a rotary and traversing motion of the grinding wheel is obtained, the whole being arranged and operated substantially as set forth."

---

3. For an *Improvement in Gun Harpoons;* Oliver Allen, Norwich, New London county, Connecticut, December 5.

Claim.—"What I claim as my invention, is the combination and arrangement of parts constituting the gun harpoon, or a harpoon calculated to carry or be attached to a line, and be discharged from a gun by the explosion of the charge thereof: or, in other words, I claim the specified combination and arrangement of the barbed head and shank with the button, the crossed strips, and the short cylinder. The peculiar arrangement of the button, with respect to the other parts, enables the line to be fixed to the harpoon at such part of it as will prevent it (the said line) from exercising, during the flight of the instrument, any action calculated to injuriously affect the straight course thereof."

---

4. For an *Improvement in Smoothing Irons;* Mary Ann B. Cook, Boston, Suffolk county, Massachusetts, December 5.

Claim.—"What I claim as my invention, is an organization or combination of elementary improvements, consisting of the rounded bevel of the lower or anterior part of the instrument, the increased weight of the anterior part over the posterior part, and lastly, the rearward pitch of the handle, as set forth; the said peculiar inclination of the handle being to prevent unpleasant strain upon the hand and wrist, and for other purposes."

---

5. For an *Improvement in Rock Drillers;* John T. Foster and Lyman R. Bailey, City of New York, December 5.

The patentees say,—"The nature of our invention consists in providing a frame of metal, or any other material most convenient, and said frame made with an arch on it, in which is a curved groove or slot, in the which is a curved sliding box attached to a drill stock; by which a spindle and chisel can be made to drill holes in rocks at any angle, and made to operate horizontally or perpendicularly; and also in employing a percussive and reactive force to the operation of drilling, by combining a spiral spring with the drill stock and spindle, and operating the same by a cam fixed on an axle of one or two power wheels, by the which contrivance a force is brought to bear upon the drilling of rocks in a far more effectual and economical manner than any heretofore known. The nature of this invention also consists in the peculiar feeding gear, as it is technically termed, by which the drill is allowed to exert the full force applied without jarring the machinery of the machine, so as to prevent the breaking of chisels. The nature of this invention also consists in having adjustable legs attached

to the frame of the machine, to accommodate it to uneven ground on which to stand, and also in providing a jointed curved chisel, to excavate a greater diameter of bore at the bottom of holes, for the purpose of more effectual explosions than by the present known plan for this purpose."

Claim.—"What we claim as new, is the combination of the arch with the sliding box or drill stock bearings, moving in a circular or curved groove, whereby the drill stock is moved to any angle of the said arch for the purpose set forth. We also claim the combination of the collar with the drill stock and spindle, by the pawls, and the pinion, and the pallets, aud for the purpose of feeding and changing gear, as set forth."

---

6. For an *Improvement in Billiard Table Cushions;* Abraham Bassford, City of New York, December 5.

Claim.—"What I claim as my invention, is the application of air or gas confined in a tube of india rubber, or other elastic material, to form the cushion of a billiard table or bagatelle table. I also claim the mode of extending the tube that contains the air or gas in one length around the table, in consequence of which the cushions (tubes) on a table may be inflated at the same time with one air pump, by which the cushions are inflated equally in every part, and by which every point receives the same elasticity."

---

7. For an *Improvement in Car Wheels;* Lyman Kinsley, assignee of James M. Cook, Canton, Norfolk county, Massachusetts, December 5.

Claim,—"What I claim as my invention, is the manner of making a cast metal chilled tread wheel, having two side plates united to the hub and rim, by the process of founding, the same consisting in making both the plates concave from the hub to the rim, whereby the core can be suffered to remain in the wheel while in the act of cooling, and the advantage of a slow reduction of temperature secured thereby; the said slow reduction of temperature permits the particles of the iron to so adjust themselves as to equally diffuse the various contractile strains; besides, the metal is more or less toughened and annealed by the process of slow cooling."

---

8. For an *Improvement in Stove Flues;* W. E. Bleecker and S. D. Vose, Albany, New York, December 5.

The patentees say,—"The invention and improvement, consists in the mode or arrangement of flues for accomplishing the following objects, viz. equal distribution of heat, increase of draft, and protection of the flue space from cold air."

Claim.—"What we claim as our invention, is the combination of the two conveying flues with a return flue underneath them, formed by a converging and diverging plate in cooking stoves, as set forth."

---

9. For an *Improvement in Plates for the Boiler Holes of Cooking Stoves;* Geo. E. Waring, Stamford, Fairfield county, Connecticut, December 5.

Claim,—"What I claim as my invention, is making the division piece

part of a contracting ring, as set forth, that it may be reversed from side to side, whereby I am enabled to divide the long boiler hole into two, one small and one large, the large one being of greater diameter than could be found with the usual division piece in the middle, as set forth."

---

10. For an *Improvement in Hand Cultivators;* E. E. Hawley, Middletown, Middlesex county, Connecticut, December 5.

The patentee says,—"The nature of my invention consists in constructing and arranging a wheel cultivator, to be used by hand, to serve all the purposes of hand hoeing."

Claim.—"What I claim as new, is the tiller, constructed as described, consisting of a frame containing the tilling implements, in combination with the wheels and axle, propelling handle, and guiding brace, the whole constructed and arranged as set forth."

---

11. For an *Improvement in Copying Surfaces by Electricity;* Alex. Bain, London, England, December 5; patented in England, May 27, 1843.

Claim.—"What I claim as my invention, is the copying of surfaces by the electric current through a single circuit of conductors, as set forth. I claim the exclusive right to the use of prussiate of potass, as the most useful ingredient in solutions of chemical compounds, for preparing paper to receive marks formed by the action of electric currents thereon, for telegraphic purposes."

---

12. For an *Improvement in Warming and Ventilating Buildings, &c.;* Henry Ruttan, Coburg, New Castle district, Canada, December, 5; Canadian patent dated 23d June, 1848.

Claim.—"What I claim as my invention, is the mode of warming and ventilating buildings, the same consisting in introducing the air from without, at some point sufficiently above the ground to get a pure air, and sufficiently low down to get clear of smoke, said air to be introduced by being conducted under the floor of the building, and directly under the furnace or stove, for the purpose of supplying air to be warmed for distribution, and after being thus warmed, rising in a central or otherwise convenient apartment or passage, and thence carried into the various rooms, by openings in the walls at the upper part or near the ceilings, without the aid of pipes, and thence downwards, through suitable openings in the lower part of the room, and thence outward through the various channels provided, connected with the foul air flue or chimney. I claim also, in the air-warming furnace, the arrangement of the radiating pipes or flues, in combination with the fire chamber, situated within or between them in the manner set forth; and, in combination with the elevated air chamber and flues, I claim the arrangement of the openings for admitting heated air above the fire to complete the combustion, as set forth. I claim the mode of constructing the grate, viz., of raising one or more cylindrical grates above the grate floor, said raised grates being capped or covered in such manner as to protect the vertical bars from the fuel, substantially as set forth. I also claim

the mode of conducting the air into my pure air shafts whatever may be the direction of the wind, viz., by placing the swinging valve or shutter at the mouth of said shafts, substantially as set forth."

---

13. For an *Improvement in Breaking and Kneading Dough;* James Cole, Cincinnati, Hamilton county, Ohio, December 12.

Claim.—"What I claim as my invention, is the elevating apron that passes around the rollers, in combination with the kneading or breaking rollers, substantially as set forth, for the purpose of carrying the dough back to the table after it has passed between the kneading rollers, as set forth."

---

14. For an *Improvement in Ice Cream Freezers;* H. B. Masser, Sunbury, Northumberland county, Pennsylvania, December 12.

The patentee says,—"My invention consists of constructing a freezer so as to revolve a dasher within it, and also at the same time to turn the freezer in an opposite direction within the ice box; and I form the spindle of the dasher large and hollow, for the purpose of containing ice."

Claim.—"What I claim as my invention, is the forming the spindle of the beater, within the freezer, hollow, so as to be filled with ice, for the more expeditious freezing of the cream, and, in combination therewith, the construction and arrangement of the freezer and beater, substantially in the manner set forth."

---

15. For an *Improvement in Railway Car Couplings;* Daniel R. Pratt, Worcester, Massachusetts, December 12.

Claim.—"What I claim as my invention, is the combination of the hooks, mortised draw bars, buffers, with the open link, made, arranged, and operated in the manner and for the purpose set forth."

---

16. For an *Improvement in Chimney Caps;* Felix A. Finn, City of New York, December 12.

Claim.—"What I claim as my invention, is curving the partition in manner substantially as set forth, in combination with the lateral openings and wings in the sides of the chimney caps, as set forth, that blasts of wind blowing in through the lateral apertures may tend to exhaust the flue and aid the draught, and by means of which, also, downward blasts of wind shall be prevented from passing down the chimney flue as set forth."

---

17. For an *Improvement in Escapements for Chronometers;* Victor Giraud, City of New York, December 12.

Claim.—"What I claim as my invention, is, 1st, the detached or independent detent, formed substantially as set forth, to give a back movement to the scapement wheel in detaching the scapement, when combined with the scape wheel and balance, substantially as set forth, whereby the impulse given to the balance by the scape wheel operates the detached detent, which, in effecting the detachment, has to force back the scape wheel,

thus making the amount of resistance of the scapement proportionate to the propelling force of the movement, as set forth. And I also claim the detached detent with two or more faces of repose, against which the teeth of the scape wheel rest, and corresponding recesses of scapement, substantially as set forth, when combined with the scape wheel and balance, whereby the detent in its operations rotates by an intermitting motion, as set forth, thus avoiding the back motion due to a reciprocating detent."

---

18. For an *Improvement in Spinning;* Wendell Wright, Cincinnati, Hamilton county, Ohio, December 12.

Claim.—"What I claim as my invention, is the employment of the spiral-threaded box, in combination with the rollers for drawing the roving, in the manner set forth, the motion being more perfect and regular than can be effected in any other way."

---

19. For an *Improvement in Franklin Stoves;* Nathaniel Cradit, Ripley, Brown county, Ohio, December 12.

Claim.—"What I claim as my invention, is the combination of the draft and damper plate with Franklin stoves provided with a notched groove to receive the same, as set forth."

---

20. For an *Improvement in the Scoop and Elevator;* Ephraim Morris, City of New York, December 12.

Claim.—"What I claim as my invention, is the application of the two-part scoop at the lower end of the frame, conjointly with the arrangement by which the toggle-joint arms close the scoops to load, when acted on by the rope or chain, which afterwards raises the scoops and load, and through which arrangement the same parts open the scoop to discharge the load, when acted on by the rope or chain, both the chains or ropes operating on the toggle-joint arms through the shafts and drums, substantially in the manner set forth."

---

21. For an *Improvement in Cooking Stoves;* Darius Buck, Albany, New York, December 12.

The patentee says,—"The nature of my invention consists, first, in the arrangement of the two ovens, one, that is the main one, at the back of the fire place, and extending, if desired, partly under it, and the other in front of the main one, extending under the open hearth, with an arrangement of flues by which the draft is caused to pass over the main oven, down two side flues at the back, along two side flues at the bottom, then uniting in a single flue under the front oven, up in front thereof, over the top, and between it and the open hearth, then down a diving flue between the two ovens, to a return flue under the main oven, and between the two side flues, and thence up through a middle flue at the back to a chimney, the said central return flue at the bottom of the main oven being provided with a sliding damper, which, when open, permits the draft, after passing through the two main flues at the bottom, to enter and pass through the said return

flue to the chimney, without passing around the front oven, so that, by means of the sliding damper, both ovens or only the main one may be heated. And the second part of my invention consists in making hot air chambers between the central and the two side flues at the back, and the two main and the return flues at the bottom, by making the partitions double: that is, of two plates, when this is combined with apertures through the bottom and back plates of the stove, for the free admission of air to be heated in these chambers, to aid in baking."

Claim.—"What I claim as my invention, is, 1st, the arrangement of the two ovens, one in front of the other in combination with the arrangement of flues, by which the draft can be made to pass over the main oven, down the back in the two diving flues, along the bottom, up the front of the front oven, over the top of it, down the diving flue between the front and main oven to the return flue, along the bottom and up the back of the main oven to the chimney, substantially as set forth. And I also claim, in combination with the arrangement of ovens and flues, the employment of the damper in the central return flue at the bottom, for the purpose of causing the draft to pass around one or both of the ovens at pleasure, substantially as set forth."

---

22. For an *Improvement in Parlor Stoves;* George E. Waring, Stamford, Fairfield county, Connecticut, December 12.

Claim.—"What I claim as my invention, is making the apertures in the cap plate, for the draft, mainly in the front part thereof: that is, over that part of the ash pan which passes through the radiating cylinder, to distribute equally the draft and the radiation of heat thereby produced."

---

23. For an *Improvement in Bell Telegraphs;* Jacob G. Day, Brooklyn, New York, December 19.

Claim.—"What I claim as new, is the parts and arrangement set forth, by which the spring slides and their latches co-operate with the slides and cams, and move the words, signs, or numbers, into place, to be seen as required, and strike the bell through their operation on the rock shaft and toe, and also allow any subsequent blow on the bell to be given by the same, or any other slides, while the previous sign, word, or number, remains in place to be seen, and to indicate that fact by the intermittent or snatching motion caused by the limited movement of the notch next the cam, on the pieces or wedge, including the means of returning the signs into the spaces between their proper openings, by the counter slides or frame."

---

24. For an *Improvement in an Apparatus for Drawing and Measuring Liquids;* John H. Hecker, Hinckleton, Lancaster county, Pennsylvania, December 19.

The patentee says,—"The nature of my invention consists in forming, in the tubes through which the liquid flows from the cask to the measure, a segment chamber containing a valve, which is moved up and down, to let on or stop off the flow of the liquid as required, by means of levers,

springs, suspended float, and other mechanical contrivances, so combined and arranged, in relation to the valve, as to close said valve and stop off the flow of the liquid from the cask, without the aid of an attendant, by the rising of the liquid in the measure acting on the float, causing the fastening (holding the valve open) to be detached from the lever to which the valve is secured, and allowing the valve to be forced down by a spring pressing against said lever. And also, in combining with the apparatus an alarm bell, which is caused to strike when the valve is closed, in order to call the attention of the attendant to the fact."

Claim.—"What I claim as my invention, is the mode of measuring liquids by means of the combination of the measure, tubes, valve, lever, hinged bar, catch, roller, springs, cord, and float, arranged and operated as set forth. I also claim the combination of the alarm with the measuring apparatus, by means of the lever and chain, for giving notice when the measure is filled and the valve or gate is shut, as set forth."

---

25. For an improvement in *Furnaces for heating Sad Irons;* Reuben Smith, assignee of Samuel Maxam, Westfield, Hampden county, Massachusetts, December 19.

The patentee says,—"The nature of my improvement consists in the combination of a pyramidal casing, with a cylindrical furnace pot, resting upon a circular plate, and the flat irons are heated by being placed in the several openings in the said pyramidal casing."

Claim.—"What I claim as my invention, is the combining with a furnace pot the pyramidal casing, provided with perforations to receive the flat irons, in the manner set forth."

---

26. For an *Improvement tn the Machine for Cutting Paper Fringe;* Peter and George Pengeot, Buffalo, Erie county, New York, December 19.

Claim.—"What we claim as our invention, is the form of the blades, by the addition of the parts which we have denominated clearing teeth, to be inserted in the same, as set forth."

---

27. For an *Improvement in Ploughs;* Neri Blatchley, Windsor, Brown county, New York, December 19.

Claim.—"What I claim as my invention, is removing earthy and other adherent obstructions from the surface of the mouldboard of the plough by means of a scraper, mounted upon a spring lever, which renders it self-acting, and which may also be operated by a string, one end of which is attached to either the lever or scraper, and the other held in the hand of the ploughman; the several parts being constructed and operated substantially as set forth."

---

28. For an *Improvement in Machinery for Boring Brush Blocks;* S. Taylor and A. R. Davis, East Cambridge, Middlesex county, Massachusetts, December 19.

Claim.—"What we claim as our invention, is the machine or combination for boring brush blocks; the combination consisting of the series of

revolving bitts, the index rod, or pointer, the revolving pattern holder, patterns, block holders, and geer wheels, applied to the lay beam, sustained by universal joints, as set forth; together with the lay bar and other mechanism for forcing the lay beam and blocks and pattern forwards against the bitts, as set forth. And as auxiliary thereto, we claim to make the lay beam moveable transversely in such manner in order to cause the bitts to pass through the blocks in directions at such angles with the front face of each of them as may be desirable to produce a proper spreading or flaring of the several bunches of bristles which may be inserted in them."

---

29. For an *Improvement in Horse Collar Blocks;* William H. Bustin, Watertown, Middlesex county, Massachusetts, December 19.

The patentee says,—"It will be seen that I do not claim the rim or groove for stretching the roll of the collar simply, but that as I so form the block that the collar would have a tendency to slip off while being stretched, the rim or groove becomes essential to preserve it in position, or hold it on the block. It is, therefore, for *such purpose* that I claim the rim or groove, in combination with the swell, or that part of the block from which the collar would have a tendency to rise, in the act of being formed and stretched."

---

30. For an *Improvement in the Sash Bearer and Fastener;* Ira Glynn, Syracuse, Onondaga county, New York, December 19.

Claim.—"What I claim as my invention, is the fastening window sash frames when closed, and retaining them in different positions when open, by means of the long and short levers with the catches, at their extremities, the springs, and thumb lever, combined and arranged with each other, and with the mortises in the sides of the sash frames, in such a manner that the thumb lever cannot be moved to disengage the fastening apparatus without first slightly elevating the sash frames, in the manner set forth."

---

31. For an *Improvement in the method of employing Water used for Condensing Steam as a Motive Power;* Joseph P. Pirsson, New York city, December 19.

The patentee says,—"The nature of my invention consists in the application of the water used for condensing the steam of a steam engine, as a motive power, for the purpose of adding to the power of the main engine, or for the propulsion of independent machinery, as may be desired.

Claim.—"What I claim as my invention, is the employment of the injection water used for condensing the steam of a condensing steam engine, as a motive power. I also claim the peculiar manner set forth, in which the force thus obtained can be applied to the propulsion of machinery.

---

32. For an *Improvement in the Manufacture of Ichthyocolla;* Ebenezer Rowe, Rockport, Essex county, Massachusetts, December 19.

Claim.—I claim the means set forth of cooling each of the cylinders,

viz: by the induction and eduction tubes placed at one end of the cylinder, and making the induction tube to extend through the eduction tube and the middle of the cylinder, and nearly to the other end of it, as set forth."

---

33. For an *Improvement in the method of Preserving the Shape of Steel Springs in the process of Tempering them;* David M. Smith, Springfield, Windsor county, Vermont, December 19.

Claim.—"What I claim, and as particularly applicable to the manufacture of curved flat springs, for trusses or for various other articles, is, 1st, the process, consisting of hardening the spring in the usual manner, when off the mould; 2d, in drawing the temper, (it being still off the mould,) to such extent as to enable me to apply it to the mould without danger of breaking it while so doing; 3d, in clamping said spring to a mould, and plunging it and the mould so clamped together into a bath of melted lead, or other suitable metal, or material or materials in a fluid state, and raised to the temperature necessary to produce the desired effect of preserving the shape of the spring, or that given to it by the mould.

---

34. For an *Improvement in Machinery for Turning Irregular Shapes;* Allen Goodman, Dana, Worcester county, Massachusetts, December 19.

Claim.—"What I claim as my invention, is the combination of the governor with the vibrating rest, cutters, and mandrils, for the purpose of turning irregular forms, whether the same be constructed and arranged as set forth, or in any other manner.

---

35. For an *Improvement in the Plough;* David B. Haight, Perryville, Madison county, New York, December 26.

The patentee says,—"The nature of my invention and improvement consists in attaching the beam to the parts with which it is connected, in such a manner that its front end can be raised, lowered, and moved to the right or left, and held there for the purpose of assisting properly the point of draught; also in attaching the point to the mould-board without bolts or loops, and in fixing a removable shoe or guard to the land-side, which can be removed as often as it becomes too much worn to perform its office properly, whereby the land-side is effectually protected from injury, and rendered as durable as any other part of the plough."

Claim.—"What I claim as my invention, is interlocking the share and mould-board together, by means of a tapering dovetailed tongue, formed on the former, which enters a similarly shaped groove made in the latter."

---

36. For an *Improvement in the Corn Sheller;* Waldren Beach, city of Baltimore, Maryland, December 26.

The patentee says,—"The nature of my invention and improvement consists in constructing the slides with turned-up lips or radial strippers, of the expansive corn sheller, of such a form that the upper strippers will overlap and break the joints between the lowers strippers, and thus form a continuous edge in the upper end of the hole through which the cob is

driven, to strip the corn from it, whether the hole be expanded, as in driving a large cob through it, or contracted, as in driving a small one."

Claim.—"What I claim as my invention, is forming and arranging the teeth slides with turned-up lips, for stripping the corn from the cob, called strippers, so that the vertical joints between one pair of opposite strippers shall be broken and covered by the other pair, in all positions of the same, whether collapsed to form the smallest, or expanded to form the largest hole, or at any intermediate point."

---

37. For a *Machine for Turning Chair Legs, &c.;* Russell D. Bartlett, Harmony, Somerset county, Maine, December 26.

Claim.—"What I claim as my invention, is the combination of two rotary mandrils and one cutting knife, (or its equivalent,) as arranged, and made to operate together. And I claim, in combination with the said two rotary mandrils and cutting knife, or machinery, for rotating and reducing the wood, the two sets of bearers and cam bars, or cams. And I claim, in combination with the connecting bar of the lever, the two foot levers."

---

38. For an *Improved Door Latch;* Robert J. Fry, District of Spring Garden, Philadelphia county, Pennsylvania, December 26.

The patentee says,—"The machine is a *door-holder*, intended to retain the hinged door, blind, shutter, lid, &c., in the position given by the operator. It keeps the door just where the operator places it after a pull or push upon the door itself, either with his hand or any other part of his body."

Claim.—"What I claim as my invention, is a double oblique catch, or holder, acted upon by a spring, in combination with the latch hook, or the edge of a door, shutter, or other hinged article, constructed and operating as above described; not intending in these claims to restrict myself to the arrangement herein described, but to vary the same at pleasure, while I attain the same end by means substantially the same."

---

39. For an *Improvement in the Piano Forte Action;* John H. Low, Boston, Suffolk county, Massachusetts, December 26.

The patentee says,—"The improvements which I have made consist, first, in the peculiar construction of that end of the hammer lever in which the fulcrum, or pivot, is placed, so that when the hammer is at its greatest height, or in contact with the strings, the point where the power is communicated from the key lever, and the fulcrum, or pivot, on which the hammer lever turns, shall be in a horizontal line, or nearly so, in connexion with an opening, or notch, between these two points, sufficient to admit the head of the jack, or fly, by which the power is communicated, allowing the jack, or fly, to work off by its own regular motion, produced by being firmly attached to the key lever, and describing a circle, of which the fulcrum of the key lever is the centre. Secondly, in forming a rest, to prevent the jack, or fly, from moving more than is necessary to allow the hammer to fall upon the back catch, thereby avoiding the noise

that is sometimes produced by the rebounding of the fly upon the surface, where it should slide smoothly."

Claim.—"What I claim as combined together, and with the hammer and fly, is the projection, and peculiar recess, with its abutment, or block."

---

40. For a *Machine for Forming, by Compression, Prismate Heads on Metallic Bolts;* William Grant, Boston, Suffolk county, Massachusetts, December 26.

Claim.—"What I claim as my invention, is the formation of heads on bolts by machinery, by first upsetting or compressing into a partially closed die a portion of the rod, by means of a punch, into a shape approximating to the form required, but of larger diameter, and proportionately shorter, and then by entirely closing the dies, and again forcing up the punch, reducing it to its proper proportions, and completing its form, whether the devices by which the several motions are produced be such as are herein described, or others capable of effecting the same results."

---

41. For an *Improvement in Cooking Stoves;* Lysander A. Orcutt, Albany, Albany county, New York, December 26.

The patentee says,—"The nature of my invention, consists in substituting in cooking stoves an open Franklin fire-place, in lieu of the usual close fire-chamber, (said open fire-place, however, being so arranged as to be capable of being converted at pleasure into a close fire-chamber,) and also in a new arrangement of flues and apertures to create a current of hot air through the oven, to carry off the moisture, &c., generated in the act of baking."

Claim.—"What I claim as my invention, is the introduction of heated air from the vacuity between the two plates at the back of the fire-place into the upper part of the oven, by means of a pipe, or pipes, which pass through the front flue, in combination with the exit passage situated at or near the bottom of the oven, and the small flues operating as herein described."

---

42. For an *Improvement in Casting Metal Pipes;* Thomas J. Lovegroove, Baltimore, Baltimore county, Maryland, December 26.

Claim.—"What I claim as my invention, is forming pipes of cast iron, or other suitable metal, by causing the mould in which the metal is poured to revolve with a velocity sufficient to cause the metal to assume a tubular form around the inside of the mould, without the employment of a core."

---

43. For an *Improved method of Sawing out Spokes, Staves, &c.;* Thomas Green, De Witt, Onondaga county, New York, December 26.

The patentee says,—"The nature of my invention consists in sawing

with the grain either straight-grained or winding timber, in such manner as to make the spoke, or other article sawed out, straight and not cross-grained, without waste of timber.

Claim.—"What I claim as my invention, is the placing the bolt and arranging the operation so that I saw with the grain straight-grained or winding timber, and make the spoke, or other article sawed, straight, and not cross-grained, without wasting the timber."

---

44. For an *Improved Piano Forte Action;* John J. Wise, Baltimore, Baltimore county, Maryland, December 26.

Claim.—"What I claim as my invention, is, 1st, the application of springs attached to a movable bar, or rail, to the key levers of the piano forte, so as to impress different degrees of force; 2d, I also claim the combination and arrangement of the turning rail, lever, and notched plate, for the purpose of graduating the force of the springs on the key levers, in order to adjust the keys for various degrees of touch, and to the physical capacity of the performer, and to the character of the music to be played. I likewise claim as my invention, attaching the "*check*" to the "*under hammer*," (instead of the end of the key lever, or to an additional lever,) by extending the "*under hammer*" beyond the "*main hammer*," so as to receive the "*check-piece*" which I attach to it in any convenient way, by which arrangement the reaction of the main hammer upon the key lever is prevented."

---

45. For an *Improvement in Hot Air Stoves;* T. H. Parker, York, York county, Pennsylvania, December 26.

Claim.—"What I claim as my invention, is, 1st, the swivel cap, constructed, arranged, and combined with the stove; 2dly, I claim the double revolving grate, in combination with the close base. I also claim the combination of the horizontal flue with the stove."

Woodworth's Planing Machine.

Opinion delivered by JUDGE KANE, *in the United States Circuit Court of the Eastern District of Pennsylvania, in the case of Wilson* v. *Barnum, on a motion for an interlocutory injunction for an infringement of a patent for Woodworth's Planing Machine, May* 31, 1849.*

A motion is made in this case for an interlocutory injuction, to restrain the defendant from further using a machine, which, it is said, infringes upon the complainant's rights under the Woodworth patent. The defendant does not contest the validity of that patent, but he denies that he has infringed it by using the machine complained of, which he asserts to be an

* From the Philadelphia Evening Bulletin, of June 4, 1849.

independent invention, and as such secured to him by letters patent, recently issued under the act of 1836.

The preliminary question is thereupon made by the defendant, whether a patent issued under this act of Congress must not, for the purposes of the present motion, be regarded as controling evidence of title in favor of the party claiming under it.

There are certainly cases under the present patent laws in which the court would enter very reluctantly upon the discussion of the validity of a patent. Some of the provisions of the act of 1836 give a quasi-judicial character to the action of the Commissioner; and it has accordingly been held, I believe generally as well as justly, that the patent itself is to be taken as prima facie evidence of the novelty and usefulness of the invention specified in it.

There are other cases in which the official action of the patent office claims properly a still higher degree of consideration. Wherever antagonist patentees or third persons generally have been first called in, it is reasonable to consider that action as a preliminary adjudication upon their rights. And this for the obvious reason, that they have been parties, or but for their own default might have been parties, to the proceeding on which the adjudication was based.

But this is the limit, beyond which comity cannot be required to go. It cannot be asked that a third person shall have his legal rights impaired, or his legal remedies impeded, by any proceeding to which he was not, and could not have made himself, a party. To hold ourselves concluded by the action of the patent office, where that action has been without notice, would be as perilous to the interest of inventors as to that of the public. We have had in our own court one case at least, in which an injunction was sought against the real inventor, on the faith of a patent granted to a surreptitious claimant. The grant of a patent to the defendant, therefore, can have no other effect on the present discussion, than as it indicates the opinion which highly respectable and skilful officers have formed on an ex-parte examination of the case.

We come, then, to the principal question: does the machine now in use by the defendant embody the principle of the complainant's patent?

The judicial definition of a patent, or of the principle it involves, in a case under trial, is properly, if not necessarily, a limited one. It regards primarily, and as a matter of course, the circumstances of the pending controversy. The identity or the difference between the two machines is sought in the first place by a comparison of them, either in their elements or as a system; and we are commonly said to define their mechanical principles, when, after making such a comparison, we indicate the essential particulars in which they are alike or otherwise. A new comparison of the patented machine with another not before the subject of adjudication, as it presents new points of similarity or variance, calls for a different expression of the principle of the patent. The aspect of the invention changes as we approach it in a new direction; and parts become prominent that were subordinate before, and that involve perhaps important relations to the question in dispute.

For this reason the cases upon the Woodworth patent, which are found in the Reports, as well as those which have been determined in this court,

give, for the purpose of the present inquiry, an imperfect definition of the principle of the invention. In all of those cases, the machine complained of carried the planks through it on an unvarying plane, which was tangential to the revolving motion of the planing knives, and the planing knives were set on the periphery of the revolver; in both of these particulars resembling the Woodworth machine. In Mr. Barnum's, the cutting tool is set on the face of a rotating disk, and the plank advances in a plane parallel, it is said, with the disk, till the operation of planing is completed, and is then deflected from the machine; thus, at the first glance, differing throughout, as well from the Woodworth machine, as from other machines with which the Woodworth has been compared on former occasions.

What then shall we regard as the principle of the Woodworth invention, when viewing it in connexion with the machine of the defendant? We shall, perhaps, be led to the answer, by tracing the history of this important class of labor-saving machines.

Before the present century, it had been deemed an object of much interest to adapt some combination of machinery to the work of smoothing the surface of boards. The mechanical difficulties in the way were these: 1. That the cutting tools, if made to work parallel to the external surface of the plank, encountering all the sand and grit that adhered to it, soon lost their edge, and became incapable of producing a uniform surface.— 2. That if the tools were made to cut otherwise than parallel to the surface, so as to pass *through* the gritty exterior instead of *along* it, the plank would be alternately driven down as the tools struck it, and lifted up as they left it, and would thus have a constant and rapid vibration under the action of the machine.

The engine devised by Mr. Bramah, in 1802, was so contrived as to get rid of the first of these difficulties. His cutting knives were placed on the side or surface of a circular rotating disk; but beyond them, at the extreme periphery, he placed a set of projecting rough cutters, which struck the plank as it advanced in the same plane with the disk, and before it reached the planing knives had removed the outer surface to which the grit adhered. His machine was imperfect, however; for, in consequence of the elasticity of the plank, as well as of the machinery, and the vibration due to the rapid but intermitting action of his tools upon the plank, his cutters, after completing their work, would, as they revolved, come in contact again with the finished surface, and score it irregularly.

Woodworth's machine was the next which I need refer to. He affixed his cutters to the periphery of a revolving cylinder, and advanced the plank towards them, under strong pressure, in a plane tangential to their motion, thus making the cutters describe a curve upwards from the finished surface through the rough surface of the plank, and preventing the plank from vibrating sensibly during the operation. This machine did its work effectively and well. The plank, moving firmly along the tangent plane of the rotating cylinder, passed beyond the reach of the cutters, and was disengaged from the action of the machine at the moment the work was perfected.

This was imitated in the Gay and the MacGregor machines, in which a flattened cone or dished plate wheel was substituted for the cylinder. By this change, the corrugated surface which is left by the Woodworth

machine was avoided; the action of the cutters being very nearly in a line parallel to the surface of the plank, and therefore producing shavings instead of the chips which are thrown out by the Woodworth cutters. But as the curve in which the cutters acted became one of a larger circle, the deflexion between it and the plane of the plank's motion was, of course, less rapid than in the Woodworth machine; thus increasing in some degree the liability of the finished part of the plank to receive the same injury from vibration, which was the characteristic defect in the action of the Bramah machine. Nevertheless, when the Gay and MacGregor machines were before this court some three years ago, it was held that they infringed upon the Woodworth principle, inasmuch as they contained the revolving cutter acting upon a plank in the tangent plane of the revolver.

The next machine to be described is that of the defendant. Its appearance is, in many respects, similar to Gay's, though it differs materially in others. It has the Bramah disk, with its two sets of rough and finishing cutters; but the plank is made, by a very ingenious contrivance, to advance along a metallic guide, either in a straight or slightly curved line, till it comes beneath the axis of the disk, when, by a turn in the guide, it is bent outwards over a small roller, and thence passes from the machine in a line similar to that by which it approached it. The finishing cutters begin to act upon the plank in a line very nearly parallel to its surface, and complete their work as the plank turns over the roller.

We have thus a machine that cuts in a right plane upon a curved surface, the revolving disk, at the moment of finishing the work, forming a tangent plane to the curve of the advancing plank. We have, too, a roller, over which the plank is forcibly bent, and which, by its resisting pressure against the elasticity of the plank, holds it steady under the action of the cutters: that is to say, we have a machine just the converse as well as the equivalent of that invented by Woodworth. One general expression may include them both: A planing machine in which the cutters and the material move against each other in a curve and in its tangent plane respectively, the material being kept from vibrating by roller pressure. It is true that, in one machine, it is the cutter which follows the curved path, while the material moves along the plane, and that in the other, the cutter moves in a plane, and the material is acted on in the curve; but there is no other difference.

Is this, then, a difference of principle? Can it be said that the essential character of a machine is varied by a mutual interchange of form and direction between the two elements of which it is a combination, while both object and effect remain as before? Does not the question, in its very terms, suggest Lord Tenterden's illustration in the Percussion Lock case, (Webster, P. C. 128,) of those analogous contrivances, the bringing up of an anvil against the hammer, and the bringing down of the hammer against an anvil?

We may recognize differences of details in the defendant's machine, both as to the means and the effect; and these may properly be patented as improvements upon the Woodworth invention, perhaps highly meritorious ones: but considered as independent combinations, I cannot escape the conclusion that, whether the plank or the cutter have the curvilinear motion, if the other moves in a plane, and the two are made to act and react upon

each other, for the same object and with the same effect, the machines are in principle identical.

My only embarrassment in arriving at this conclusion has been owing to the fact that, of the highly educated mechanicians whose affidavits have been taken in the cause, the greater number have expressed a different opinion. The consideration, which was so eloquently pressed in the argument, that the responsibility of deciding this question might with propriety be devolved on a jury, has had no influence with me. That judicial morality might be impeached for infirmity, which could shrink from awarding to a party his remedy after ascertaining his rights. "The right of a party to the most speedy and effectual protection against a meditated wrong is as complete as his right to redress for wrongs already inflicted, and the accident of position confers no right on one party, whether he be plaintiff or defendant, at the expense of the other. The special injunction of equity, like the arrest on mesne process at law, may be abused to the injury of an opponent; but it is no less on that account the duty of the Judge to further them both, when, in the exercise of his best discretion, he believes that they are called for by the merits and the exigency." This was the language of the court when this patent was before us formerly, and my experience since has not taught me that it ought to be modified. The preventive interposition of equity is very often the only effective resort of a meritorious patentee; and where the facts of the case are not controverted, I am by no means satisfied that it is not the safest for both parties.

There is no conflict of evidence here: the question is of deduction and opinion. Were the case at this time under trial at bar, it would be the office of the judge to interpret the specification and define the principle of the invention. This is the only point of difficulty, and it must be encountered by the judge, whether he sits on one side or the other of the court.

To send the cause to a jury would be to delay its adjudication for many months; leaving the complainant, in the meantime, with his legal rights suspended, and swelling the measure of the defendant's ultimate liabilites. I should do injustice to both parties, were I, with my present views of the merits of this controversy, to refuse the injunction.

Interlocutory injunction awarded till hearing or further order.

For the complainant, Mr. St. Geo. T. Campbell, Mr. W. H. Seward, of New York. For the defendant, Mr. W. L. Hirst, Mr. Stoughton, of New York.

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of the Patent granted to Alexander Angus Croll, *of the County of Middlesex, for Improvements in the Manufacture of Gas, and in Apparatus to be used in Transmitting Gas.*—Sealed August 22, 1848.

My invention consists,

First, of improvements in setting retorts and apparatus for making gas from coal.

Secondly, my invention consists of a mode of employing steam passed

through highly heated carbon, and then mixing with carburetted hydrogen as it is distilled from coal.

Thirdly, my invention consists of so employing sulphurous acid gas as to combine with sulphuretted hydrogen gas, and to cause the sulphur of the gases to be thrown down or precipitated.

Fourthly, my invention consists of improvements in apparatus to be used in transmitting gas. And in order that my invention may be most fully understood and readily carried into practice, I will proceed to describe the means pursued by me.

It has heretofore been proposed to employ long retorts capable of being fed at each end, and in such manner that the products of gas from the last charge shall pass over the charge which has been for a length of time in the retort, for which purpose each such retort was provided with a rising-pipe at each end, to carry off the gas evolved first from one end of the retort, and then at the other, the different ends of each retort being fed at distinct intervals, so that the two charges therein will at all times be in a different state of process, one charge being comparatively fresh whilst the other charge will be comparatively spent.

Now the first part of my invention consists of using similar retorts, that is, retorts which can be fed at each end, but in place of having two rising-pipes, one at each end, as heretofore, for carrying off the produced gas, I have only one rising-pipe, which I apply at one end of a retort, and then, in place of feeding the two ends alternately, and at distant periods one from the other, I charge both ends at the same time, by which arrangement I have found considerable advantage result in the manufacture of gas.

I will now describe the second part of my invention, which has for its object the use of steam passed through carbon at a bright red heat, and then causing it to pass over or amongst the charge of coal which is being distilled in a retort. For this purpose I prefer to use retorts such as above described, and at the end most distant from the rising-pipe I charge the retorts with coke, and have a steam-pipe to convey steam into the retort at that end, and at the other end of the retort I from time to time supply a charge of coal, say at every five hours, and allow steam to flow in for about the first three hours of each charge; and I have found that about fifteen gallons of water evaporated and caused to pass into retorts for each ton of coals, (that is, when Newcastle coal is used, but when Kennel coal is used the quantity should be increased,) produces the most advantageous working, but I do not confine myself to the use of that quantity. The object being to obtain a larger quantity of gas of a fair illuminating power, and a less produce of tar.

I will now describe the third part of my invention, which has for its object the use of sulphurous acid in such manner as to deprive carburetted hydrogen gas of the sulphuretted hydrogen gas with which it is contaminated, and thus to obtain the sulphur of both compounds in the form of flour of sulphur.

I first make a solution of sulphurous acid in water, by connecting a vessel or vessels of cast iron, (arranged as a Woulfe's apparatus used for impregnating liquids or gases,) with an oven or other suitable apparatus for carrying on the co mbustion of sulphur, and by means of an air-pump or other arrangement for producing a draft, connected with the vessel con-

taining the water or liquid to be impregnated, I cause a current of sulphurous acid gas, from the burning sulphur, to pass through the water or liquid, and by which it is largely absorbed. This I do till the liquid is nearly saturated with sulphurous acid, and to effect this about six ounces of sulphur will require to be burned for every gallon of water.

The sulphurous acid thus made I transfer to the first of a series of three vessels, (or, it may be, other number of vessels,) constructed and arranged exactly in the same manner as the wet-lime purifiers in common use at gas works; the other two vessels are charged with a weaker solution, derived after the process has been once put in operation from the washers to be afterwards mentioned, and by a portion of the sulphurous acid which is disengaged from the first vessel. I charge each of these vessels exactly as is done with the liquid in the wet-lime purifiers, videlicet, so that the gas may pass through and come into extensive contact with the solution of sulphurous acid; and I cause the gas to pass first into the vessel with the strong solution, and thence into the second, and thence again into the third.

In thus passing through these successive purifiers, the sulphuretted hydrogen in the coal gas, and the sulphurous acid, are both decomposed, and sulphur is abundantly deposited. When the sulphurous acid in the first vessel has been all decomposed, or nearly so, the contents must be discharged into a suitable reservoir, where the liquor may settle or be filtered, and the sulphur obtained and dried.

The vessel must then be charged with a new solution, and the process proceed as before. But I prefer in practice, instead of using a separate vessel, as already described, for preparing the solution of sulphurous acid, to use two setts of purifiers alternately, and therein to charge the liquid with sulphurous acid in the one set when the coal gas is being passed through the other, and instead of using fresh water for this purpose, I transfer the liquid already partially charged from the second to the first, and the contents of the third I transfer to the second, as in like manner the third has been charged from the washers now to be described.

I find that, owing to the volatility of the sulphurous acid, a portion of it is carried over with the gas, and, therefore, to free it from this impurity, I cause it to pass through three other vessels, which I call washers; and finally, that every trace of impurity may be removed, I pass it through a common dry-lime purifier. The freedom from impurity may be ascertained at any stage of the process by the usual test of acetate of lead for sulphuretted hydrogen, and by the smell, if there be even a most minute portion of sulphurous acid present.

These washers are arranged so as to be put in connexion with either series of purifiers at pleasure, and any construction may be adopted by which there is a free passage for the gas, and a thorough exposure of it to the water, and for this purpose the ordinary lime purifiers already referred to, answer very well. In the washers these are charged with water only, and as it becomes impure, it is transferred through the series onward, and then into the purifiers, the last vessel of the series being always supplied with the fresh water, and care being taken that it never gets so charged with sulphurous acid as to allow of its being disengaged with the gas. Such is the general mode of procedure, that in practice it is not necessary

to discharge or transfer the contents of the purifiers every time they are impregnated with sulphurous acid, but only when the accumulation of sulphur, tar, &c. renders it necessary, and also if more water be required in the washers than it is necessary to transfer to the purifiers, then it may be run out, and, after depositing its sulphur, may go to waste.

I will now describe the fourth part of my invention. It has heretofore been proposed to have gas-holders fixed at a distance from the works in order that they may be near or in the locality where the supply is to be given, and it has been proposed to aid the transmission of gas from the works by means of exhausting apparatus.

Now the fourth part of my invention consists of apparatus similarly arranged to that above mentioned: that is, a gas-holder or gas-holders at a distance from the works, together with exhausting apparatus to take the gas from the main and drive it into the gas-holder or gas-holders near such exhausting apparatus.

And the peculiar character of this part of the invention consists of so working that the gas in the main between the gas-works and the exhauster, in the vicinity of the gas-holder, at a distance, may be maintained at a proper degree of pressure for supplying the intermediate district. For this purpose I cause the exhausting apparatus to be capable of taking the gas to such an extent as to exhaust the gas-main, so that if no provision were made for maintaining the gas at a proper degree of pressure in the main, no supply of gas to the intermediate district could take place from the main. When the exhausting apparatus is at work, I cause there to be a branch-pipe from the main to the gas-holder, such branch-pipe being connected at a point from the gas-holder beyond the exhausting apparatus, and on such branch-pipe I apply a governor, which I prefer to be such as are now used at gas-works to regulate the pressure of gas in the mains. By this arrangement, although the exhausting apparatus will, at all times when at work, be propelling gas into the gas-holder from the gas-main, with a tendency to exhaust the main, a quantity of gas will pass from the gas-holder by the branch-pipe into the main, which quantity will be regulated by the governor, which will thus keep the gas in the gas-main at the desired working pressure, and the gas-holder or gas-holders, at a distance from the works, will only be supplied by the exhausting apparatus with the quantity of gas which would otherwise cause the gas in the main to rise in excess of the desired working pressure.

Having thus described the nature of my invention, and the manner in which the same is to be performed, I would have it understood that I do not confine myself to the details herein described, so long as the peculiar character of any part of my invention be retained,

But what I claim is,

First, The mode of manufacturing gas herein described, whereby retorts capable of being fed or charged at each end are employed, the gas being conveyed off at only one end.

Secondly, I claim the mode of employing steam in the manufacture of gas, as above described.

Thirdly, I claim the purifying coal gas by employing sulphurous acid gas, so as to separate and thus obtain the sulphur in the form of flour of sulphur; and,

Fourthly, I claim the mode of arranging apparatus for transmitting gas, as herein described.—[*Inrolled February* 22, 1849.

Lond. Rep. Pat. Inv., April, 1849.

Specification of a Patent granted to WILLIAM HENRY KEMPTON, *of Pentonville, for improvements in Reflectors and Apparatus for Artificial Light* —Sealed November 7th, 1848.

This invention relates, firstly, to improvements in the manufacture of reflectors, and, secondly, to improvements in apparatus for artificial light.

The improvements in the manufacture of reflectors consist in making them of earthern or pottery ware, and then producing a silver lustre on the surface thereof, in the same manner that such silver lustre has heretofore been produced on tea cups, saucers, and other articles.

The second part of this invention is explained by figs. 1, 2, 3, 4, 5, and 6. Fig. 1 exhibits a reflecting lamp for lighting shop windows from the outside. The advantage resulting from this lamp is its great reflecting power, at small cost compared with plated metal; and the novelty consists in the reflector *a*, which composes the body of the lamp, being made of earthern or pottery ware, and coated on the inside with silver lustre. The construction of the lamp is also simplified and improved, first, by the supply-pipe for the gas being introduced through the chimney of the lamp, and, secondly, by the use of a convex circular glass, inserted into a hinged rim, for the front.

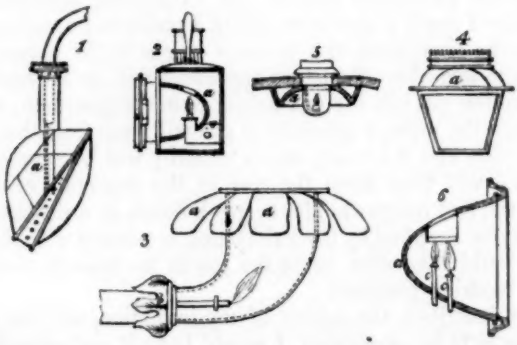


Fig. 2 represents a parabolic railway signal lamp. In this lamp, the case for the reflector and the burner being in one piece, the reflector (which is made of earthenware coated with silver lustre) can be easily attached to the burner, and will not be liable to get out of focus; it will also be less liable to damage from the heat of the lamp; will not be likely to be impaired by change of temperature; and will be altogether a much cheaper article than the plated metal reflector.

Fig. 3 shews what is termed the cornucopiæ light. The patentee says that this is a perfectly original mode of burning gas in glasses—the flame being made to issue horizontally from the burner, instead of vertically; by which plan the shadow from the burner and fittings is thrown back upon

the branch, and not upon the table or desk over which it is placed. The air to support combustion is admitted through the leaf *b*. The reflector *a* may be used in combination with the burner and glass, or not, as may be preferred.

Fig. 4 exhibits a street lamp, the top or roof, *a*, of which is to be made of earthen or pottery ware, coated with silver lustre; but in other respects the lamp is of the ordinary description.

Fig. 5 shews a drop roof lamp for railway carriages, combined with a reflector. The lamp may be of any suitable construction. The reflector *a* is fixed to the roof of the carriage, and is made of such a form as to admit of the lamp being dropped through it.

Fig. 6 represents a gas stove. The silver-lustre reflector *a* is made of a parabolic or conical shape, and is to be fixed in the recess of the fire-place, or in an open space; *c c* are the gas-burners. The patentee states that it is also intended that coals or charcoal should be burnt in a grate placed in the focus of a reflector of a parabolic or other shape, and the heat reflected into the apartment. He is aware that it has been before proposed to employ gas for heating rooms; he does not, therefore, claim the same generally, but only the mode of arranging the apparatus with a reflector constructed according to the first part of this invention.

The patentee claims, firstly, the manufacture of reflectors, by applying pottery or earthenware, coated with silver lustre. Secondly, the conveying the supply of gas through the chimney, and the application of the convex glass front, as described with reference to fig. 1; also the arrangement of railway lamp shewn at fig. 2; also the arrangement of the gas-burner and apparatus, as shewn at fig. 3; also the construction of the upper part of a lamp with a reflector, as shewn at fig. 4; also the arrangement of drop roof lamp for a railway carriage, as shewn at fig. 5; and also the arrangement of apparatus and reflectors for a gas or fuel stove, as shewn at fig. 6. —[*Inrolled May*, 1849. Lond. Jour. Arts, June, 1849.

Specification of a Patent granted to Thomas Drayton, *of the County of Middlesex, for improvements in Silvering Glass and other Surfaces.*—Sealed December 4, 1848.

This invention relates to silvering glass without the use of quicksilver, for which Mr. Drayton obtained a patent November 25, 1843*. It consists in causing silver to be deposited from a solution of that metal upon glass, in such manner that a precipitate of silver will adhere to the glass without any previous coating being applied thereto; and it also consists in coating other substances with silver in the same way.

The mode of carrying out the invention is as follows:—One ounce of hartshorn or ammonia, two ounces of nitrate of silver, three ounces of water, and three ounces of spirit, (spirit of wine being preferred,) are carefully mixed together; the mixture is allowed to stand for three or four hours, and then it is filtered. To each ounce of the filtered fluid is added a quarter of an ounce of saccharine matter, dissolved in equal parts of spirit and

* For description of this invention, see Lond. Journ. Arts, Vol. xxiv, p. 421; and Journ. Frank. Inst., Vol. viii, 3d series, p. 193, Sept. 1844.

water, say about half a pint each. The patentee states that the saccharine matter which he prefers to use is grape sugar, the solution being allowed to stand for a few hours. The liquid may be used for depositing silver either upon horizontal or vertical surfaces, provided it is kept in contact with the glass, which is to be kept heated to about 160° Fahr., until the required deposit of silver has been obtained. As soon as the silver upon the glass is perfectly dry, it may be varnished with common mastic varnish, to preserve it from being injured by friction.

The patentee states that this invention may be employed for depositing silver upon looking glasses and every other description of glass, either hollow or having a flat surface. The process is not at all unhealthy or injurious; and no smell of any kind arises during the operation of silvering, or after the glass has been silvered. The superiority of this process over the ordinary one consists in the production of a coating of silver of great durability, and capable of withstanding heat as well as damp to a very extraordinary extent. It is stated that the solution will deposit silver upon metals in a very perfect manner.

The patentee does not confine himself to the precise details above described, provided the peculiar character of the invention be retained, whereby silver is deposited on to glass from a solution of that metal, in such manner as to cause the silver to adhere to the glass without any previous coating of the latter, and without the use of oils.—[*Inrolled June*, 1849.

Lond. Journ. Arts, July, 1849.

MECHANICS, PHYSICS, AND CHEMISTRY.

Report on the Gases evolved from Iron Furnaces, with reference to the Theory of the Smelting of Iron. By Prof. Bunsen, *of Marburg, Hesse Cassel, and* Dr. Lyon Playfair, *of the Museum of Economic Geology, Department of Her Majesty's Woods and Forests.*

From the Report of the British Association for the Advancement of Science, for 1845.

(Continued from page 147.)

On the Application of Furnace Gases to Practical Purposes.

In this division of the subject we have to consider the useful purposes to which these gases may be applied when employed as fuel. Their practical value does not so much depend on the amount of heat capable of being generated by their combustion, as upon their maximum temperature; and both these conditions may be exhibited by examining the composition of the various mixtures of gases obtained from different depths in the furnace. But it would be erroneous to suppose that the values thus obtained by calculation expressed, in all cases, the average practical effects capable of being derived by their application on the large scale, for such a conclusion would only be justifiable when the numbers obtained by analyses expressed the average value. That this is not the case has been shown in the above considerations as to the proportion between the nitro-

gen and oxygen, for we observed at the depth of fourteen feet, when the gases were richest in combustible materials, this relation was the least observed. Even in the highest layer of the gaseous mixture, the constituents of which may be viewed as most intimately mixed, we obtain a combustible value more than one-third greater than the above, when we estimate it according to the composition of the materials thrown into the furnace, and the products of distillation of the coal. In order, therefore, to found our calculations on a firm basis, we will estimate the practical value of the gases according to the results obtained in our former calculations, as to the limits of variation in the value of the gases, when deduced from the composition of the materials with which the furnace is supplied. This mode of proceeding will safely lead us to numbers expressing the average value, and will enable us to repose upon them with confidence, from the assurance that the results capable of being obtained on the large scale, must be much greater than those expressed by calculation.

Our experiments have proved the combustibility of the entire column of gas, even when cold, from a depth of twenty-four feet to the mouth of the furnace. Hence it follows that the gas collected from any point to this depth is capable of being applied as fuel. It would be objectionable, however, to conduct the gas from a deep region of the furnace, because we should thus draw off the heat necessary to support the process of coking the coal in its upper part. The gas might be collected from the upper part of the furnace without any detriment to the process, and with additional advantage as fuel, because, while it contains all the combustible products of distillation, it is not deteriorated by having taken up any incombustible ingredients. This circumstance greatly facilitates the application of the combustible gases, for it removes the obstacle to their use in furnaces fed with charcoal. In the latter, the zones of distillation and reduction lie more closely together, and the proportion of ore and limestone to the coal is so much greater than in this country, that the amount of carbonic acid evolved obliges the withdrawal of the combustible gases from a low region of the furnace, where the reduction of the ore and evolution of carbonic acid have been completed. But the withdrawal of the gaseous fuel from a region below that of the reduction necessarily produces such disturbance in the operations of the furnace, that only a small part of these gases dare be removed, while the largest portion must still be allowed to remain and administer to its necessities. The advantage to be derived from the use of the gaseous fuel in this country will therefore be the more obvious, when we consider that its application cannot derange any of the processes essential to the reduction and smelting of the ore. In furnaces fed with charcoal, the gaseous fuel has been collected and applied without any great difficulty, by building into the wall of the furnace a circular channel, supplied in the inner part with a grating, so as to prevent its obstruction by the materials introduced into the furnace. The gases stream freely through this channel, even though the furnace is left entirely open, and though the pressure is so inconsiderable as scarcely to affect a water manometer. The great pressure of blast used in English furnaces led us to the conviction that in them the column of gas must be much more compressed, and we have confirmed this opinion by a series of measurements on a water manometer attached to the tube through which the gases were

collected for experiment. The pressure of the gases expressed by the height of the column of water at various depths is as follows:—

5 feet,	- - - -	0·12 inch.
8 "	- - - - -	0·40 "
11 "	- - - -	1·10 "
14 "	- - - - -	1·60 "
20 "	- - - -	1·80 "
23 "	- - - - -	4·70 "
24 "	- - - -	5·10 "

This table proves that even in the highest portion of the gaseous column, the pressure is considerably greater than in that region of the furnace from which the gases are withdrawn in Germany.

Hence it follows that hot-blast furnaces fed with coal are peculiarly well-adapted for the economy of gaseous fuel, which may be conducted from the furnace, and applied without in any way interfering with its operations.

We have already shown, on the very lowest calculation, that at least 81·54 per cent. of valuable fuel must escape from the mouth of the Alfreton furnace. Now as about fourteen tons of coal are used in that furnace every twenty-four hours, it follows, according to our experiments, that 11·4 tons of coal are lost every twenty-four hours, by escaping in the form of gases still capable of being used as excellent fuel.

We have previously shown that the temperature capable of being attained by the combustion of these gases is 3083° Fahr., (1695°·2 C.,) and, by using a blast sufficiently heated, this could easily be raised to 3632° Fahr. (2000° C.) Now, as Pouillet has shown that cast iron melts at 2192° Fahr., (1200° C.,) it follows that the gases of hot-blast furnaces fed with coal, when burned with hot air, would yield a temperature more than sufficient to melt iron.

The gases of our furnaces fed with coal contain a very valuable constituent, which is entirely absent from the charcoal furnaces of the continent. This substance is ammonia, which is present in such abundance as to be sensible to the smell in the gases collected from the deeper parts of the furnace. We have, therefore, devoted our special attention to this valuable ingredient, and have arrived at the conclusion that it is possible to economise it in the most simple manner. The ammonia may be obtained in the form of sal-ammoniac, if the gas, previous to its application as fuel, be conducted through a chamber containing muriatic acid. In collecting the ammonia in this manner, there need be little fear of any considerable deposition of tar, for the product of distillation flows back upon red-hot coal, and is so completely decomposed, that the tube, thirty feet long, used by us for a period of twelve hours in collecting the gases, scarcely contained a trace of tar, although its temperature was not sensibly higher than that of the surrounding air. If the solution of sal-ammoniac produced by the condensation of the ammonia be allowed to flow into an evaporating pan, over the surface of which a small part of the flame of the combustible gas is allowed to play, a convenient arrangement of the liquid, and of the burning stream of gas, would enable us to obtain a constant flow of a con-

centrated solution of sal-ammoniac as an auxiliary in the manufacture.—The advantage of its collection is, that, without any further consumption of fuel, or any considerable expenditure of labor, a valuable commercial ingredient would be economised. Hence it is of importance to estimate how much ammonia we might hope to obtain in this way; and this is easily determined by the quantity generated during the distillation of coal. We have subjected the furnace coal of Alfreton to various trials, both by distilling it *per se*, and along with a mixture of soda and lime, and then by separating the ammonia in the usual way from the liquid products of distillation, by means of chloride of platinum.

I. 2·887 furnace coal of Alfreton, heated with soda and lime, yielded 0·0801 chloride of platinum and ammonia.

II. The experiment repeated with 5·687 coal, gave 0·175 chloride of platinum and ammonium.

III. 20·455 grms. distilled *per se*, gave a product collected in muriatic acid, which, after separation of the tar, yielded 0·7681 chloride of platinum and ammonium.

Hence 100 parts of the furnace coal of Alfreton yields the following quantities of sal-ammoniac:—

I.	Experiment, - -	0·666
II.	" - - -	0·739
III.	" - - -	0·902
	Mean, - - -	0·769

Now, as 280 cwt. of coal is consumed in the Alfreton furnace every twenty-four hours, it follows that more than 2 cwt. sal-ammoniac might be obtained from it as a subsidiary product, without increasing the cost of manufacture, or in the slightest degree disturbing the process of smelting.

We have confined ourselves, in this examination, principally to the consideration of the furnace coal of Alfreton, but we may naturally expect considerable differences as to the amount of nitrogen in other coals used in this and in other countries. The estimation of the nitrogen, with regard to the possibility of applying the ammonia generated by their distillation, thus becomes a question of considerable importance. We therefore reserve for ourselves the prosecution of this inquiry in a succeeding paper. Before leaving this subject, however, we have to allude to some experiments, showing the facility of condensing the ammonia.

As the gases from the upper parts of the furnace are saturated with aqueous vapor, which condenses along with the ammonia in the lead tube with which they were collected, we have taken the proportion of the ammonia carried away in the gases, so as to compare it with that which had suffered condensation. For this purpose, the gases flowing through the iron and lead pipes, sunk from eight to ten and a half feet beneath the charging-plate, were conducted through muriatic acid for two hours and seven minutes. We determined the volume of the gas passing through the acid by collecting it at various times during the experiment in a balloon made of gold-beater's skin, of the capacity of 380·8 cubic inches, observing the time which was required to fill the balloon. The mean result, which de-

viated only slightly from the individual trials, showed that the gas required 1′ 7″ to fill the balloon, and therefore that 43304·76 cubic inches have passed through the muriatic acid. The examination of the muriatic acid used in the experiment gave 0·198 grm. chloride of platinum and ammonium, corresponding to 0·0152 ammonia. If we assume as the composition of the gases that formed at a depth of eight feet, we can easily calculate the quantity of coal necessary to produce the above 43304·76 cubic inches of gas. According to analysis, 1000 cubic centimetres of this gas contain 547·7 cubic centimetres of nitrogen. We have already seen that nitrogen is not produced from the materials introduced into the furnace, and hence all the amount present must have been introduced by the blast as atmospheric air, which, burning before the tuyère, mixed with the gaseous products of distillation in the upper parts of the furnace, and produced the above 547·7 cubic centimetres of nitrogen. But as this amount of nitrogen is derived from atmospheric air, it implies that 143·84 cubic centimetres, or 0·2066 grm., of oxygen has been consumed in the lower part of the furnace by uniting with 0·1549 grm. of coke, in the formation of carbonic oxide. But, as has already been shown by a previous experiment, 0·2304 grm. of coal must have been distilled to produce the 0·1549 grm. of coke; and as the above quantity of coal is required to generate one litre of the above gaseous mixture, 163·5 grm. must have been employed in the generation of the 43304 cubic inches of gas washed by the muriatic acid. Hence it follows that only 0·0093 grm., or 3·77 per cent. of the ammonia generated from 100 parts of the coal (which according to our experiments amounts to 0·2463 grm.) pass over along with the gases; so that the remaining 0·2370 grm., or 96·23 per cent. of ammonia, must have been condensed in the water of distillation found in the tube. In fact, we ascertained that the lead tube contained a clear liquid so strongly charged with ammonia as instantly to render blue reddened litmus paper held over it. These experiments prove how easily the ammonia might be condensd, even without the intervention of an acid.

It will be observed that the gases from the inferior parts of the furnace contain cyanogen, the presence of which is highly interesting, not only in a theoretical, but also in a practical point of view. This gas appears immediately over the point of entrance of the blast, and again disappears at a small elevation above it, so that at the top of the boshes only traces of it are observed. The compound of this substance with potassium appears to play a most important part in the furnace, although its functions have apparently been altogether overlooked. This is the more surprising, as it has long been known that cyanide of potassium effloresces on the walls in certain states of the furnace. We have been fortunate enough to elucidate the conditions of its formation, and to fix its region in the furnace. In obtaining information with regard to the formation of this cyanogen gas, it was necessary to withdraw the gases from the vicinity of the hearth of the furnace, and through the kindness of Mr. Oakes, we were enabled to bore a hole over the *Front* of the furnace, two feet nine inches above the level of the tuyère. As soon as this hole was made a gas issued from it, possessing strong illuminating powers, and burning with a yellow flame, from which came abundant vapors of white smoke. On introducing an

iron pipe into the hole, without allowing it to pass into the furnace, it was retained sufficiently cool to prevent its fusion, and we were enabled to collect the volatile products. The gases which poured out of this tube under a pressure of several feet of water, were so richly laden with vapors of cyanide of potassium, that we were obliged to use precautions in approaching its opening, so as not to suffer injurious consequences from this poisonous material. Although the conducting tube was twenty-two feet in length, the amount of cyanide of potassium carried along with the gas was so considerable as to fill, in a very short time, glass tubes of one-eighth of an inch in width, and we therefore endeavored to obtain an approximative result as to the amount which thus passed over with the gases and escaped condensation in the long tube. The opening of the iron tube was connected with an empty Woulf's-bottle, to which another was attached containing water, in such a manner that the gas had to stream through a layer of four inches of the latter. The first of these bottles became quickly filled with a rich white sublimate of dry cyanide of potassium, while the water in the second became a tolerably concentrated solution of the same substance. It was now necessary to determine the quantity of gas which passed through the bottles, and this we ascertained by accurately noting the time employed in the experiment, and the exact period necessary to fill a balloon of known capacity attached to the second bottle.

1. Duration of the experiment, 24 minutes.
2. Mean time required to fill the balloon, 25 seconds.
3. Capacity of the balloon, 380·8 cubic inches.

Hence it follows that 21,933 cubic inches of gas passed through the bottle. The cyanide of potassium in the Woulf's-bottles and their connecting tubes were made into one solution, which weighed 381·024 grms., and 129·211 grms. of this solution yielded 0·62208 grm. cyanide of silver, which was easily decomposed by fuming sulphuric acid. Hence, in the 21,933 cubic inches of gas which had passed through the flasks, there must have been 0·8944 grm. of cyanide of potassium held in mechanical suspension. We have already seen that the gas possessed the following composition:—

Nitrogen,	58·05
Carbonic oxide,	37·43
Hydrogen,	3·18
Cyanogen,	1·34
	100·00

The 21,933 cubic inches of gas, admitting only its approximative estimation, its temperature being neglected, must contain 1192·97 grains of carbon, corresponding to 1774·79 grains of coal. Hence, out of 100 parts of coal at least 0·778 of cyanide of potassium are generated; and as 31,200 pounds of coal are consumed every day in the furnace, it is obvious that at least 224·7 lbs. of cyanide of potassium are generated daily in the Alfreton furnace, and hitherto have been altogether lost.

When the iron tube used in the experiment was withdrawn from the

furnace, it was found to be encrusted with melted cyanide of potassium, which speedily deliquesced in the air. On bringing it in contact with water, a considerable quantity of hydrogen gas was evolved, obviously due to the presence of reduced potassium, or to its compound with carbonic oxide. In the tube itself at least three or four times the amount of cyanide of potassium was condensed, so that we may be quite certain that the amount formed is far more considerable than we have stated. With these unexpected results before us, it became of importance to determine the origin of the large quantity of potassium in the furnace. At first, we conceived that it might be present in the limestone, which not unfrequently contains carbonate of potash, according to the researches of various chemists; but on examining as much as 30 grammes, we were unable to detect in it the smallest trace. However, we were informed by Mr. Charles Oakes that he had detected the presence of potash in the iron ore, and we are glad to be able to confirm the result of this talented young chemist. We have subjected an average sample of the calcined ore to analysis, according to the methods usually employed in such cases. The quantity used in the analysis was 2·324 grms., which yielded 1·400 peroxide of iron, 0·153 alumina, 0·145 carbonate of lime, 0·202 phosphate of magnesia, and 0·599 silica. In order to estimate the amount of potash, 17,936 grms. were ignited with carbonate of barytes dissolved in muriatic acid, and the bases, after separation of the silica, were as much as possible precipitated by carbonate of ammonia. The solution was then freed from barytes by means of sulphuric acid, and the excess of the latter removed by evaporation with chloride of strontium. In this way the remaining bases were converted into chlorides soluble in alcohol, and the solution mixed with chloride of platinum and evaporated to dryness in the water-bath, left a residue, which, treated with alcohol to dissolve out the other chlorides, consisted of pure chloride of platinum and potassium, and weighed 0·689 grm. This analysis gives the following composition for the calcined ores:—

Silica,	25·775
Peroxide of iron,	60·242
Alumina,	6·583
Lime,	3·510
Magnesia,	3·188
Potash,	0·743
Manganese,	traces.
	100·000

Another source of the potash was found to be in the coal, although to a less extent than in the ore; 1.627 grm. of the coal, dried at 212°, yielded 0·122 grm. of water; 0·2865 grm. gave 0·7865 grm. of carbonic acid and 0·153 grm. of water; 2·887 grms., heated with the mixture of soda and lime, gave 0·0801 of chloride of platinum and ammonium. The experiment, repeated with 5·687 grms., gave 0·175 of the above salt; 13·059 grms. of coal yielded 0·3505 grm. of ashes, which did not effervesce with acids; and this quantity of ashes, treated as in the case of the iron ore,

gave 0·046 grm. of chloride of platinum and potassium. The coal, therefore, is composed as follows:—

Carbon,	74·98
Hydrogen,	4·73
Oxygen,	10·01
Nitrogen,	0·18
Water,	7·49
Silicates,	2·61
Potash,	0·07
	100·00

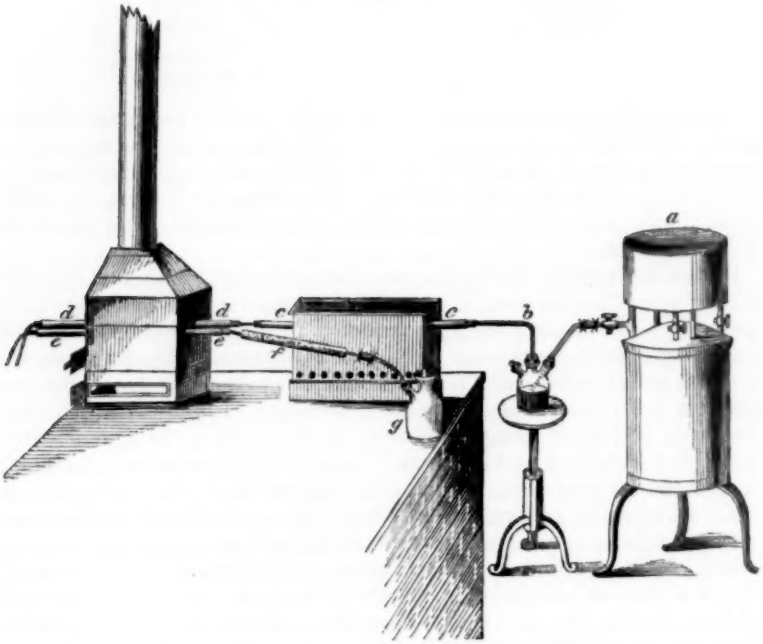
The quantity of ironstone consumed by the furnace every twenty-four hours is 33,600 lbs., and that of coal 31,200 lbs., so that the furnace receives every day, in these materials, 271·48 lbs. of potash, corresponding to 377·3 lbs. of cyanide of potassium. Thus these analyses render intelligible the large quantity of potash which we observed in the inferior parts of the furnace.

But we have yet to discuss the most interesting and important question bearing upon the presence of cyanide of potassium, viz. the origin of its cyanogen. We know how easily ammonia, in contact with carbon at high temperatures, is converted into cyanide of ammonium. Hence we should be apt at once to admit that the formation of cyanogen is due to the ammonia so freely evolved from the coal during its distillation; and if this view were correct, the existence of one must arise from the destruction of the other. But when we view more closely the circumstances under which the cyanogen is produced, we are compelled to admit that the ammonia cannot take part in its formation. The hearth, at which the formation of cyanogen takes place, is the deepest and hottest part of the furnace, and it would be absurd to suppose that the coal which reaches this part could contain a trace of ammonia, exposed as it has been for eighty hours to a red heat, and in one part to a temperature sufficient to reduce potash.—Hence we are compelled to adopt the only remaining conclusion, that the nitrogen of the air introduced by the blast combines directly with carbon to form cyanogen. This direct formation has been argued for by various chemists, and supported in this country by the experiments of Fownes and Young. But as it has been objected to experiments of this kind, that they were instituted without reference to the ammonia of the air, which is apt to be taken by most substances exposed to it, it is scarcely to be wondered at that the direct generation of ammonia is still doubted by distinguished chemists. We have, therefore, thought it necessary to determine this disputed question by an experiment which seems to banish all sources of error. We have led simultaneously, and under exactly the same conditions, a stream of carbonic acid and another of nitrogen, at a very high temperature, over a mixture of two parts of charcoal from sugar, and one part of chemically pure carbonate of potash, and have subjected the products to careful examination.

The apparatus used by us in these experiments is represented in fig. 9; *a* is a gasometer, from which a uniform stream of air is made to pass through a bottle filled with sulphuric acid (*b*), and then through a gun-barrel (*c c*)

filled with copper turnings. The gun-barrel is kept in a furnace, so that the air passing through it is thoroughly deprived of oxygen, and passes into the gun-barrel (*d d*) filled with the mixture of charcoal and potash, and heated to a temperature sufficient to reduce potassium. In the same furnace is placed another gun-barrel (*e e*), filled with the same mixture, and over which is passed a stream of dry carbonic acid from the apparatus *f g*.

Fig. 9.



When both the systems were completely filled, one with nitrogen, and the other with carbonic acid, the streams of gas were allowed to pass slowly over the mixture of potash and charcoal, both the tubes in the same furnace being kept at a temperature sufficient to reduce potassium. The gas passing out of the tube filled with carbonic acid had all the characters of pure carbonic oxide, being transparent, inodorous, and burning with a pale blue flame, without depositing any kind of sublimate. The tube over which nitrogen passed emitted a gas richly laden with a white smoke of cyanide of potassium, which sublimed in such quantity as to stop the conducting tube. When the nitrogen was passed so slowly through the sulphuric acid that the bubbles passed only once in a second, its absorption by the potash was complete, and no gas appeared at the mouth of the gun-barrel; but as soon as the temperature was lowered, so as to be under that necessary for the reduction of potassium, the absorption of nitrogen ceased. The contents of the tube over which carbonic acid had passed were examined after cooling, without the detection of the smallest trace of cyanide of potassium. The mixture treated with nitrogen, on the other hand, dis-

solved (with the exception of its charcoal) with a very powerful odor of hydrocyanic acid. The solution exhibited all the reactions of cyanide of potassium, and yielded 6·982 grms. of cyanide of silver, which dissolved (with decomposition) in fuming sulphuric acid, without leaving any residue of chloride of silver after being diluted with water. Hence we cannot for a moment demur to the following conclusion,—That a considerable quantity of cyanide of potassium is formed in iron furnaces immediately above the point where the blast comes in contact with the glowing fuel, and that it owes its formation to a direct union of carbon with potassium and nitrogen of the air.

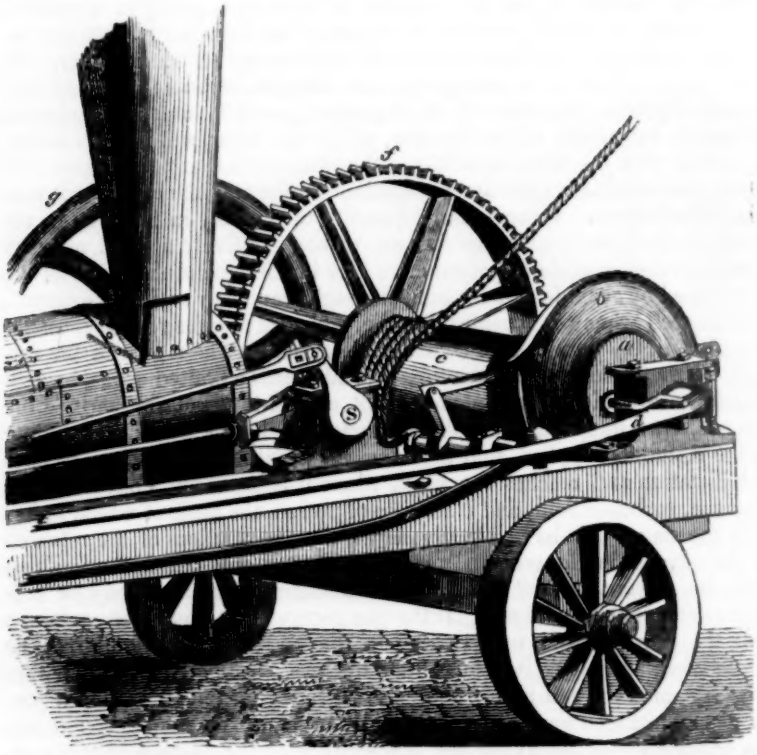
Our experiments have further shown that cyanide of potassium is volatile at high temperatures, and this property is of much influence in the part which it takes in the reducing process of the furnace. Carried up by the ascending current of gas, the cyanide of potassium, partly in a state of vapor, partly as a solid, reaches the region of the furnace in which the reduction is effected, and here it exerts its well-known reducing power. In consequence of this it is decomposed into nitrogen, carbonic acid, and carbonate of potash, the former of which passes up with the ascending gaseous column to the mouth of the furnace, while the latter, not being volatile, falls back with the other materials in the furnace, to that point where it is again converted into cyanide of potassium, under the influence of the carbon and nitrogen. Hence a large quantity of ore may in this way be reduced in the lower part of the furnace, by comparatively a small quantity of regenerated cyanide of potassium. The importance of this view of the part played by cyanide of potassium, although previously entirely neglected, will be seen when we consider that this powerful reducing agent must accumulate in the furnace to a considerable extent. The region of the furnace where the highest temperature prevails forms a limited space, beyond which the cyanide of potassium cannot extend to the lower parts of the furnace, until its quantity is so much increased, by the potash descending in the materials supplied, that the excess of cyanide of potassium escapes volatilization and reaches the blast, where it is burnt and converted into nitrogen, carbonic acid, and carbonate of potash, the basis of which unites with the slag. We have already shown that the relation of the nitrogen to the oxygen in the gaseous mixture, collected only two and a half feet over the tuyère, is 79·2 : 22·8, after deducting a quantity of oxygen corresponding to the hydrogen. If the gas generated at this place contained only the nitrogen and oxygen due to the air, the proportion would be 79·2 : 20·8; and hence it follows that the gases at this point must either have obtained oxygen from a source independent of the air, or that a proportion of nitrogen has been abstracted from them. Any one who has had the opportunity of observing the temperature of the furnace at this part, will at once agree with the opinion that the excess of oxygen cannot be derived from the carbonic acid or iron ore. A simple inspection of the materials enables us to reject such an explanation as erroneous, for the fused materials flowing from the furnace do not evolve gas, although they come from a point in the immediate vicinity of that where the oxygen has been taken up.

We must, therefore, admit that this phenomenon is connected with the formation of cyanide of potassium in the furnace. The potash, as it yields

its oxygen to carbon during its conversion to cyanide of potassium, assumes for every volume of oxygen lost by it, two volumes of nitrogen in the form of cyanogen, and consequently the proportion of nitrogen to oxygen is necessarily increased.

Improved Portable Steam Hoisting Machines for Loading and Discharging Cargoes. *By* A. L. ARCHAMBAULT, *Philadelphia.*

This useful invention, of which the annexed cut is a representation, was built for Charles Bentric, a stevedore of Philadelphia, who has successfully tested it in discharging the cargoes of the ships Austria, Monongahela, and Hercules.



The operation of the machine is briefly as follows:—The motion of the engine is communicated to the fly-wheel shaft S, which carries a small pinion gearing into the large wheel *f;* the winding barrel *c*, to which the hoisting rope is attached, is locked to the shaft of the wheel *f* by means of the driving friction coupling *a*, the latter being thrown into or out of action by the lever *d;* and the motion of the drum *c*, when free from the shaft of the wheel *f*, is controlled by the friction band *b*, which is tightened or slackened by the brake *e*.

The machine requires but a single person to keep up steam and attend to the brakes, and is capable of hoisting twelve hogsheads of tobacco from the hold of a vessel and turn them out on the wharf in ten minutes, or can discharge cotton at the rate of three hundred bales per hour. In case the hogshead or other article being raised should strike on the combings of the hatchway, the engineer has only to slacken the brake, and it is lowered, without stopping the motion of the engine, so as to clear the obstruction, and then, by drawing the lever of the brake tight again, the ascending motion is restored. The lowering brake is so arranged that a hogshead of tobacco can be suspended at any point required with the greatest ease. The machine being on wheels, is portable in its character, and can be moved about with a single horse.

A machine of this description should be procured by the stevedores of every sea port, California not excepted.

For the Journal of the Franklin Institute.

An Essay on the Physics of Steam. *By* Thos. Prosser, C. E., *New York.*

(Continued from page 136.)

That steam must be either saturated or surcharged will be readily admitted, and therefore, although the fact of its issuing from a high state of elasticity into the atmosphere, at the temperature due to saturated steam under that pressure, does not, *per se*, prove it to be surcharged, yet, taken in connexion with another fact, viz. that such steam does not scald the hand, affords certain proof that there is some physical difference between expanded steam and steam which has not been expanded; and as only two states of existence are known—saturated and surcharged—it necessarily follows that, on the score of probabilities, we are entirely justified in assuming that it is surcharged, in the absence of any reliable direct experiments on the subject.

It has been mentioned before that low pressure steam is a conductor of electricity, and I may now add that high pressure steam is a non-conductor,* but what bearing this has on the cause of expanded steam being surcharged it is difficult to say, in the present state of our knowledge of that most mysterious agent; whether, as the cause, in consequence of the electricity being converted into heat, which Pelsier has shown to be possible,† or simply as another effect of the same cause.

The electricity of effluent steam was first noticed by an engine-man at Seghill, about six miles from Newcastle,‡ England. The first observations on the electricity of a jet of steam, while issuing from a boiler, is contained in a letter addressed by H. G. Armstrong, Esq., to Professor Faraday, and published in the 17th volume of the London and Edinburgh Magazine, Oct. 14, 1840. There are also some very interesting remarks on the same subject in this Journal, 3d series, Vol. I, p. 123. Evaporation is undoubtedly the great source of electricity in the atmosphere, as well as in the boilers of steam engines, and there appears nothing irrational or unphilo-

*Journal of the Franklin Institute, 3d series, Vol. 1, p. 123.
† Noad's Lectures on Electricity, p. 250, ¶ 408.
‡ Noad's Lectures on Electricity, p. 252.

sophical in supposing that the converse of this may also be true, knowing, as we do, that heat and electricity, if not identical in nature, are at least mutually convertible into each other.

When the electric spark is passed through oxygen and hydrogen gases, mixed in the proper proportions to form water, or as eight to one equivalents, a flash is seen to pervade the whole mass, which is instantly changed and converted into steam at a pressure of 14 atmospheres, the temperature of which must therefore be in the neighborhood of 387° F., even on the supposition that the mixed gases are of the same density as saturated steam, the one at the common temperature, and the other at the elevated one; but how does the matter stand in this respect? 66⅔ cubic inches of hydrogen gas will weigh 1·412 grs., and 33⅓ cubic inches of oxygen gas will weigh 11·296 grs., or eight times as much, making together 12·708 grs. as the weight of 100 cubic inches. This is about the same weight as 100 cubic inches of steam at a pressure of 25½ inches of mercury, and a temperature of 203° F.; but 14 atmospheres is equal to 420 inches of mercury, and if we imagine that the pressure will increase $\frac{1}{480}$ for each degree from 32°, we have the enormous temperature of 10,262° F., which is but 300° less than the reputed temperature of iron at a welding heat, before the required pressure is obtained; such is the energy with which electricity acts in composing water, when its constituents are thus brought into proximity. The decomposition of water is a very slow process, however, for it is reasonable to suppose that an equal amount of power is necessary, but there are no means known, by which sufficient energy of action can be produced to decompose a single drop of water, with anything like the rapidity with which the composition is effected. Hence it is difficult to imagine that the decomposition of water in a boiler can take place to any dangerous extent, even under the most favorable circumstances; but it is easy to see that if, under the combined influence of heat and pressure, free electricity should be generated, the sudden opening of a valve may scatter the water among the steam, and if, at the same time, the free electricity be converted into heat, we have ample reasons for expecting an explosion in any boiler so circumstanced, without approaching, except in a slight degree, the temperature which would appear necessary to decompose water.

MM. Jobard and Tassin support some such theory as this, and it does certainly account for many explosions that have taken place, and which no other does account for so rationally.

The cases alluded to are those in which there are several boilers in connexion, and which commonly explode simultaneously or nearly so, just as would be expected where the agent in operation was one of uncontrolable power. It appears to me that, to imagine free electricity as the effective agent in bursting boilers, in such cases at least, is far more rational than to assign it to free caloric, because dry or surcharged steam would appear to be particularly harmless, unless some such agent as electricity is brought to operate upon it, for, as steam, it must necessarily become surcharged by some means before it can be dangerous as an exploder, and the immense quantity of heat to be abstracted from the surcharged steam, and, if you please, from the red-hot boiler also, which disappears or becomes latent before steam of any great elasticity can be formed, precludes the idea of

so slow a process as evaporation must necessarily be, unless some new and more energetic medium than ordinary is brought into operation.

To give an illustration of this, let us imagine steam at 100 lbs. pressure to the square inch, the temperature of which will be 329·6° F., and the volume 293 times that of the water from which it was formed; now in order to double this pressure instantaneously, (for it must be remembered that it is almost thus that the most terrific explosions do occur: that is to say, when first set in motion after having been for a time in a state of rest,) it is necessary that ·464 times as much water as that which already exists in such steam should be raised, together with itself, 54·8° F.; but this is a small part of the amount of the heat which must be abstracted to effect the contemplated change of elasticity, as 827·6° have disappeared or become latent in the fresh steam generated, being equal to 384° of the whole steam in the boiler, which is now at a pressure of 200 lbs. to the square inch, and temperature of 384·4°, occupying 147 times the volume of water from which it was generated; thus the whole heat which has to be developed instantly as it were, amounts to no less than 438·8° (= 54·8 + 384°). It is not very apparent how such an occurrence can take place by any well-known and ordinary means, but if it did, one boiler might burst, but it is altogether inexplicable how all of a suite should follow, as though they were so exactly of the same strength that they must inevitably stand or fall together, which no one at all acquainted with the mechanical skill (or rather the want of it) of some of the western boiler makers, would for a moment suspect. It would rather appear to me that some subtle agent, such as electricity, must be in operation, whose power is so far beyond the elasticity of any boiler, that the strength of the metal of which it may be made is not of the slightest importance.

The electric theory does not appear to be in favor with Dr. Albans, in his very excellent work on the high pressure steam engine, as it may interfere prejudicially with his pet. The Doctor seems to have no opinion at all of steam at less than 8 or 10 atmospheres, to which, indeed, he appears to have descended out of deference to public opinion rather than to his own, as his "first love" was probably much higher, and he has coquetted with steam at 60 to 70 atmospheres pressure.

For the Journal of the Franklin Institute.

Side Wheels and Propellers for Sea Steamers.

As this city is justly entitled to the credit of having done more to introduce the screw propeller to the public than any other, it is but just that *some* of the numerous patentees of that article who reside here should demonstrate the advantages that mode of propelling has over the much abused side wheel. From reading the city items of our daily papers for two years past, I had supposed that side wheels, for sea steamers, were among the things that *were*, and that we should no more see those large wheel houses which, from propeller reports, were so very objectionable at sea. You may judge of my surprise, when visiting New York, to find that all their sea steamers had side wheels, and that many more of the same kind were building. Being very well booked up on propellers, from reading the

items before mentioned, I thought I should certainly be doing them (the New Yorkers) a benefit by explaining to them the many advantages of the screw over the side wheel, thereby saving them thousands of dollars, and benefiting society in general. I therefore informed them that, with equal power, a screw vessel would cost less money, carry more freight, and go faster at all times; and that, with head winds and heavy weather, the propeller was much superior. These facts I enforced with all the ability I possessed, and all good men will allow that my exertions merited some reward. But you may judge of my astonishment when told by them that I was behind the times, that propellers might do where money was scarce and speed no object, but for a city that had money, enterprise, and go-aheadativeness, screws were *too slow*, the machinery made too much noise, from its high velocity, and as for speed, their side wheel steamers could easily beat our propellers at any time, and in head winds, with heavy sea, a propeller was not good for much; that our "Columbus" was often seen beating at sea, (when the wind was ahead,) like a ship, and much more of the same tenor, and they finally wound up by saying that they were a *humbug* compared to side wheels, and pointed to the Cunard Steamers, the New Orleans Steamers, the Chagres Steamers, the Savannah Steamers, the Charleston Steamers, the Bremen Steamers, and to six large side wheel steamers building, and after so doing, asked me *what I had to say.* Having had my say before hand, and not being prepared for opposition, I immediately came home for further information based on facts, which I now respectfully solicit from the friends of side wheels and propellers.

JOHN JONES.

Particulars of the new Iron Steamboat John Neilson, running from New York to New Brunswick.

This fine steamer was intended to be the foundation of a new epoch in steam navigation, and has received all the attention that could be bestowed upon her by her builders, the Messrs. Stevens, and it is a source of regret that she does not come up to their expectations.

The novelty in this boat was the forcing through the bottom several jets of air, under a pressure of 3 to 4 pounds to the inch. There were about 75 jets, of different sizes from 1 to 4 inches; each jet had a guard at its mouth, to direct the air aft; the bottom of the boat was flat, and her mid-

ship section like the annexed sketch, having four projections or keels of 3 inches deep, which were for guiding the air the whole length of the hull, where it escaped at the stern, it being supposed that a great advantage would be gained by a decreased draft of water and reduced friction while running. The following are her dimensions:—

Length on deck, - - -	180 feet.
Breadth of hull, - - - - -	28 "
Depth of hold, - - -	8½ "

The engine has a 56-inch cylinder, 12 feet stroke, cutting off the steam at 6½ feet. Water wheel, 32 feet diameter and 10 feet face; paddles 28 inches deep; number of revolutions per minute, 20. Two boilers, 14 feet

6 inches long, 10 feet 7 inches wide, and 8 feet high, each having two furnaces, 7 feet long, and 4 feet 7 inches wide; each furnace has but one lower flue running to the back end of the boiler, and 180 two-inch tubes above, making 360 tubes in each boiler 10 feet long. The furnaces are supplied with air by two blowers, driven by two engines, with cylinders 12 inches in diameter and 12 inches stroke, making 50 revolutions, and geared 6 to 1. The air for the bottom of the boat is forced through by two blowing cylinders, 40 inches in diameter and 4 feet stroke, making 60 double strokes per minute; each cylinder is worked by a steam engine, with cylinder 16 inches in diameter and 4 feet stroke, cutting off at one-half. All of the engines exhaust into the condenser of the large engine.

The hold, for about 100 feet, is occupied by machinery, which requires an extra number of persons to attend it, and, from the high velocity of some portions, it makes more noise than usual.

In departing from established usage and developing new principles, all persons are likely to err: the enthusiasm connected with the new idea destroying the common sense attached or belonging to the old. The Messrs. Stevens have been thus misled, and from some experiments on a canal boat *in a canal*, which gave them a high result, they immediately projected the "John Neilson," (having first secured the patent,) and promised at least 30 miles per hour, at the same time adopting a model which, at this time, would be considered barbarous by the most ignorant ship-builder in the country. Imagine a boat of the midship section before given, with a lean bow, and a stern to this sketch, the full width being carried aft, similar to a canal boat, and then think of 30 miles per hour. With the

blowing cylinders in operation, the boat makes about 15 miles per hour, and the large engine will make 1¼ more revolutions when the blast is on the bottom than when it is off, while boats of the usual form and equal power will make at least three miles more, from which it is plain that the only gain is a loss, by the new arrangement. But this is only proved a loss so far as the "John Neilson" is concerned, for the air certainly helps *her*, and they find it advantageous to use it; and if it helps her, would it not assist a boat having as good a model as could be obtained? I think it would, and I have no doubt, the Messrs. Stevens will be ultimately rewarded with a moderate increase of speed. The projectors of new ideas rarely succeed at first, but I hope soon to hear of the more perfect development of their plan. D.

Translated for the Journal of the Franklin Institute.

Method of Determining the Quantity of Phosphoric Acid in Soils by means of a Normal Liquor. By M. E. Cottereau.

This method is based, first, upon the property which solutions of potassa and soda possess of transforming, at the boiling temperature, insoluble phosphates into the soluble phosphates of these bases; and, secondly, upon the property which nitrate of silver possesses of precipitating, at ordinary temperatures, these phosphates, by forming a phosphate of silver whose com-

position is Ag^2O^2, PO^5, and which is more and more easily deposited, leaving the liquor above, more and more clear, as the precipitation is more nearly complete, which allows the moment when the reaction has ceased to be easily determined.

The following is the method of operating: The phosphoric acid of the compound to be examined having been precipitated in an insoluble form, a known weight of these insoluble salts is boiled with four times its weight of carbonate of soda, dissolved in from 8 to 10 times its bulk of distilled water. The liquid is filtered, to separate the insoluble carbonates and other salts, and the filter twice washed with boiling distilled water. The filtered liquids are then thoroughly mixed, and divided into two exactly equal portions, which are separately introduced into two small mattrasses. To these liquids are then added, little by little, a test liquid, so made that each cubic inch represents a known quantity of nitrate of silver. The liquid used by M. Cottereau was made by dissolving in a litre of distilled water 48·57 grms of pure fused nitrate of silver, so that each cubic centimetre of the liquid represents 0·04857 of nitrate of silver, corresponding to 0·01 centigramme of phosphoric acid. After every addition the liquid is to be shaken, and the additions of liquid and agitations are continued until the liquid, when left at rest, becomes perfectly clear, and this clearing only takes place, as we have said, when the saturation is perfect. By a little care, the proportion of the acid may be determined to the half of a hundredth.

The proper precautions must, of course, be taken to avoid precipitating the chlorides and sulphates with the phosphates.

The phosphate of silver obtained may be always reconverted, by carbonate of soda, into phosphate of soda and carbonate of silver, which latter, being decomposed by nitric acid, reproduces the test liquid. The expense of the operation is, therefore, but small.

Comptes Rendus de l'Academie des Sciences, 22d Jan., 1849.

Translated for the Journal of the Franklin Institute.

Quantity of Gold from the Ural and Siberia.

We take from the Archives of Physical and Natural Sciences, published at Geneva, the following account of the production of the gold mines of the Ural and of Siberia, in 1847.

The washings of the auriferous sands gave, in the year 1847, the following results:—

Washings of the Ural, ...	324·628 pouds.
of Nertschinsk, ...	25·000
of Eastern and Western Siberia,	1431·315
Total product of the Russian washings,	1780·943 pouds.

Or about 29,100 kilogrammes (77,969·6 lbs. troy) of gold.

The Russian poud is 16,342 kilogrammes.*

To complete the account of the Russian production of gold in 1847, we

* According to Kupffer, (*Travaux de la Commission des Mesures et des Poids, dans l'Empire de Russie*, 1841, *tom.* 1, *p.* 331,) the value of the Russian poud is 16,381 kilogrammes, which would but slightly alter the above results.—[Ed. Fr. Journ.

must add the gold of the Altài, and of the silver mines of Nertschinsk, which is 45 pouds; so that the total production is 1825·943 pouds, or about 29,835 kilogrammes (79,938·9 lbs. troy) of gold in 1847.

The following table shews the increase of the product of this important working.

Aggregate of the Net Product of Gold in Russia.

Year.	Pouds.	Increase.
In 1839,	529·8	
1840,	584·0	55·2
1841,	690·2	106·2
1842,	679·9	289·7
1843,	1294·9	315·0
1844,	1342·0	47·1
1845,	1371·8	29·8
1846,	1722·7	350·9
1847,	1825·9	103·2

It appears that the space susceptible of being profitably worked—which is left to future generations—is immense.

Translated for the Journal of the Franklin Institute.

Action of Magnetism on all Bodies. By M. Edmond Becquerel.

At the meeting of the 21st May, 1849, of the Academy of Sciences of Paris, M. E. Becquerel communicated a memoir upon the effects of magnetism upon all bodies, the results of which are given in the Comptes Rendus of that date.

The following are the general deductions, the proofs of which will be anxiously looked for by men of science who have paid attention to the recent experiments on diamagnetism.

1. "All bodies become magnetic, as soft iron itself does, under the influence of a magnet, but in a greater or less degree according to their nature."

2. "The temporary magnetism of a body does not depend upon its mass, but on the manner in which the ether is distributed in the body."

3. "A substance is drawn towards a magnetic centre, by the difference of the actions exerted upon this substance and upon the volume of the medium displaced by it."

The effects were measured by the torsion developed upon small bars of the various substances, by an enormous electro-magnet. The continual oscillations are prevented by suspending under each bar a little sphere of lead or zinc, immersed in water or a solution of chloride of calcium.

"Measuring in this way the actions exerted upon substances moving in different media, I convinced myself of the enormous influence exerted by the surrounding medium. Thus, common glass, which, in the air, is attracted by the two poles of a magnet, is strongly repelled by these same poles when in solutions of iron or nickel; sulphur and white wax, which, in the air, are repelled by the centres of magnetic action, are, on the con-

trary, attracted when they are immersed in concentrated solutions of chloride of calcium or chloride of magnesium."

The following are his remarks upon the third general law announced above:—

"Thus a body is attracted or repelled by a magnetic centre, according as it is immersed in a medium less or more magnetic than itself; just as a balloon filled with gas falls to the surface of the earth, or rises in the atmosphere, according as the gas is more or less dense than the air. This third principle is, therefore, analogous to the principle of Archimides as to gravity, with this difference: that the latter applies to the mass of the body, while the magnetic intensity developed in a substance, by induction, in nowise depends upon it. Hence it results that the attractions and repulsions exerted upon different bodies, by either pole of a magnet near which they are brought, depend upon the same cause, and not upon two different orders of phenomena. In fact, under the conditions in which the experiments were performed, the attractions and repulsions follow the same laws, and vary in the same way, proportionally to the square of the magnetic intensity."

To explain the fact that all bodies are not attracted by the magnet in vacuo, and that certain substances, such as bismuth, sulphur, phosphorus, &c., are almost as much repelled in vacuo as in air, "it is necessary to admit that the etherial medium, by means of which magnetic actions are transmitted, is influenced in the same way but in a different degree in a void space, and in one containing matter; and that a void space behaves like a medium more magnetic than the substance which is most repelled: that is to say, bismuth."

"Certain gases, such as nitrogen, nitrous oxide, hydrogen, and carbonic acid, experience no appreciable action from the magnetism, in comparison with the torsion of a silver wire 0·045 mm. (0·018 in.) in diameter, and 35 centimetres (14 in.) long, but that oxygen is sufficiently magnetic to have its action easily measured. The air is also magnetic, and as its magnetic power is only about the fifth of that of oxygen, it follows that the effect is due solely to the presence of this latter gas."

"While seeking to shew the magnetic power of oxygen, by some method other than that by the differences of attraction and repulsion, which shew themselves, with small bars of glass and wax immersed successively in vacuo and oxygen, it occurred to me to measure the action exerted by the magnets upon little cylinders of charcoal which condense certain gaseous substances in large proportions. I then found that *a small bar of charcoal, which has condensed oxygen, oscillates between the poles of a strong magnet like a small magnetized bar*, whilst, in vacuo, it is in general repelled, and always feebly influenced by the action of magnetism."

"Comparing the power of oxygen with that of iron, we conclude that 1 cubic metre (10·78 cu. ft.) of air has an action represented by 11 centigrammes (1·65 grains) of iron. If we reflect that the earth is surrounded by a mass of air equal in weight to a stratum of mercury 76 centimetres (30·4 in.) in depth, it may be asked whether such a mass of magnetic gas, continually agitated and submitted to variations, both regular and irregular, of pressure and temperature, does not interfere in the phenomena dependent upon terrestrial magnetism, and perhaps in the diurnal variations

of the magnetic needle. In fact, if we calculate the magnetic power of this fluid mass, we find it equivalent to an immense sheet of iron, rather more than $\frac{1}{10}$th of a millimetre (0·004 in.) in thickness, and covering the whole surface of the globe."

"Finally, we may then regard as demonstrated the principles announced above, to wit: that all bodies obey the action of magnetism, but in different degrees, and that the repulsions which shew themselves, of the two poles of a magnet upon certain substances, are due to the fact, that these substances are immersed in a medium more magnetic than themselves, which medium, by its reactions, gives rise to the effects observed. I do not, therefore, admit any difference between what has been called *diamagnetism* and magnetism properly so called."

For the Journal of the Franklin Institute.

Formula for Making Hyposulphite of Soda.

A Subscriber in the South, who practises the photogenic process, has met great difficulty in procuring the *pure* salt called Hyposulphite of Soda, free from sulphate of soda, and will therefore feel greatly obliged if any of your numerous correspondents will publish the formula or receipt for making the same.

In answer to a Subscriber, we offer the following as a good method of preparing hyposulphite of soda.

A strong solution of caustic soda is saturated with sulphur by boiling, and sulphurous acid gas passed through the clear solution, drawn off from the excess of sulphur, until a small quantity filtered off shows that the liquor has a pale yellow color. It is now filtered, evaporated rapidly until it has a syrupy consistence, again filtered if the liquid be cloudy, mixed well with half its volume of spirit of wine, and set aside to crystalize. The crystals are hyposulphite of soda. When the crystals contain too much sulphur, re-crystalization with alcohol will render them pure. The caustic soda lye is made by dissolving three pounds of crystalized carbonate of soda in two gallons of water, adding one pound of caustic lime previously slacked with one and a half to two quarts of water, boiling the liquid, letting it stand to settle, and decanting the clear liquid. The sulphurous acid is made by heating a thin paste of oil of vitriol and charcoal in a flask, with a tube passing from the cork and under the soda lye. J. C. B.

Machine for Manufacturing Printing Type.

The Earl of Rosse gave his third Soirée as President of the Royal Society on Saturday last. There were several models and inventions exhibited, the most remarkable amongst the latter being a machine for manufacturing printing types without fusing the metal and pouring it into moulds. The inventor, M. Petit, effects his process by the use of steel dies and matrices, which, by means of powerful pressure, impress the letters, &c., on copper fashioned into quadrangular strips of indefinite length wound round a cylinder.

The hardness of ordinary copper over type metal is in the proportion of

100 to 1. A London firm employed to print stamps for the Government, is in the habit of using raised copper surfaces for the purpose, no less than 125,000,000 impressions have been taken from one of their plates. The density of the copper used in the manufacture of type is considerably increased by the compression which it undergoes by the machinery of M. Petit. The machine produces thirty-two types per minute; and it would be difficult to exceed the typographic neatness of the character. Specimens of the type and printing were distributed among those present.

Lond. Athen., June 2, 1849.

Quantity of Ammonia in Atmospheric Air.

By a series of well-conducted experiments, M. Fresenius has determined that 1,000,000 parts of atmospheric air contains during the day 0·098 parts of ammonia, equal to 0·283 parts of carbonate of ammonia. During the night the same amount of air contains 0·169 ammonia, equal to 0·474 carbonate of ammonia. These results are known to be slightly in error, there being actually more ammonia in the air; they are, however, the closest approximations which have been made. Ibid. June 23, 1849.

For the Journal of the Franklin Institute.

It being the intention of persons in the direction of the construction of water works, to add a considerable expense in placing the pumps under the surface of the water to be raised, the writer is desirous of knowing what advantages will accrue in this arrangement, theoretical or practical, over the operation of pumps placed say five feet above the surface.

If any of the scientific readers of the Journal will be kind enough to give their opinion and reasons, and, if possible, data proving advantages, they will confer a favor upon a learner. A. B.

Philadelphia, August 25, 1849.

FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Report on M. Villeroi's New Surveying Instrument.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination—"A new Surveying Instrument," invented by M. Villeroi—

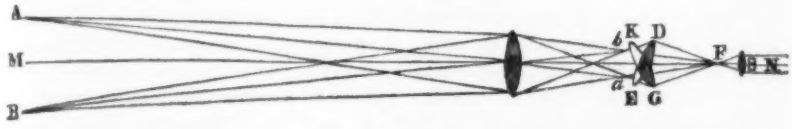
Report:—

That this instrument is intended to give the distances between the stations by means of a single observation through the instrument, without the necessity of using a chain or any other measuring apparatus.

It consists of an ordinary telescope, such as is used in the common level, but having attached to its eye-tube an appendage which we proceed to describe.

To the inner end of the eye-tube is screwed another tube of equal diameter, and divided throughout its whole length by a vertical partition or diaphragm. At the extremity of this tube, next the eye-piece, is placed a ring containing a bisected lens, D E G K, the two halves of which are

Fig. 1.



equally inclined on opposite sides of the vertical plane, perpendicular to the axis of the telescope. The eye-tube is itself divided by a vertical diaphragm, which abuts against this system of semi-lenses, and is prolonged very nearly to the eye-piece S. In adjusting the instrument these two diaphragms must coincide accurately in the same plane, which is easily arranged by tightening or loosening the screw which connects the two tubes. The foregoing figure will make this arrangement easily understood.

The target staff (fig. 2) carries two targets, projecting on opposite sides of the staff, and at right angles to it. The lower half of each target is colored black, the upper half white. The upper target is stationary, and from its centre line a graduated scale proceeds downwards along the staff as far as is necessary. The lower target slides upon the staff, and carries an index opposite to its centre line, which indicates the degree of graduation to which its position corresponds. To understand the operation of this instrument, let us suppose the target staff erected at any distance, and the telescope adjusted to the eye of the observer. Let us consider, first, the upper target. The rays from this, which fall upon the object glass C, (fig. 1,) will form an image of the target in the instrument, from which image the rays will strike upon the two inclined lenses, which will form two images, one above and one below the axis, unless, however, the inclination of the lenses to the vertical plane perpendicular to the axis be very small, these two images will be too far apart to be both in the field of the instrument at the same time. Let us suppose that the lower image is alone visible. Now the lower target will also produce two images of itself, of which the upper one will be in the field of the instrument, and it is very evident that, by sliding it up or down on the staff, causing it to approach to, or recede from, the upper target, we can find a position in which the images of the two targets coincide, and their central lines then appear as one horizontal line crossing the staff.

Fig. 2.

The mathematical theory of the refraction of light through lenses shows that, when this is the case, the distance between the lines will be very nearly proportional to the distance of the target from the instrument, and the error made by assuming this proportion as strictly true is exceedingly

small in any case, and diminishes as the distance increases, and at reasonable distances will be within the probable error of observation.

If, therefore, any instrument of this kind be placed at one extremity of a carefully measured line, and the distance between the targets at the other extremity be ascertained when the images of the centre lines coincide, this distance, divided into equal parts, will furnish the graduated scale necessary for the instrument.

The accuracy of the work performed by this instrument will depend, as well upon the care in determining the exact point at which the two lines coincide, as upon the precision with which the reading of the scale is effected. The rodman will, therefore, have a greater responsibility thrown upon him than at present, from which, however, the surveyor may relieve him by inspecting the staff himself previous to its removal from its station. Neither observation, however, is difficult, and the Committee do not believe that any practical difficulty will be found to arise from them.

The greater rapidity with which work can be done by this instrument presents a very great advantage, and the Committee think that, under certain circumstances, such as surveying in rocky, bushy, or swampy grounds, it will be found very valuable. It also allows the easy determination of distances in places where direct measurement is impossible, such as across broad sheets of water.

The Committee, therefore, believe the instrument of M. Villeroi to be a valuable addition to our surveying apparatus.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, April 12th, 1849.

Report on the Catoptric, Dioptric, and Catadioptric Systems of Lights for Lighthouses.

Appendix containing the Notes referred to in the Report.

Continued from page 166.

NOTE 3. Report of I. W. P. Lewis; also, the Annuaire, by Arago; the Report to the British Parliament of 1845, with the appendix to the same, and the Notes of Stevenson, all before cited.

Also, Report of the Committee of the Royal Society of Edinburgh, Prof. Forbes, Reporter, (cited in doc. 138 and 258, previously cited, also page 60 of doc. 488, previously cited.) The Committee were Greenock, Robinson, Trail, Christison, and Forbes.

Also, Letter from Leonor Fresnel, (not the inventor of the Fresnel lights,) the Secretary, to the Commissioners of Lights, (France,) 31st December, 1845, in doc. 488, previously cited.

Extract from page 118 *of this document.*

COMPARISON OF THE TWO SYSTEMS OF LIGHTS.

[Parallel between the Catoptric and Dioptric Lights.]

I will consider the two systems under the following heads:—

1st. The *absolute useful and economical effects.**

2d. The *first cost of the establishment*, and of *the repairs* and *maintenance.*

3d. The *facility* and *safety* of the service.

[Apparatus of the 4th order, smaller model.]

Sec. 1. *Absolute useful and economical effect of the illuminating apparatus.*—The brilliancy of a catadioptric apparatus of 30c. (11·8 inches) interior diameter, illuminated by a lamp burning 45 grammes (1 ounce $9\frac{4}{10}$ drachms avoirdupois) of oil per hour, has been found to be equal to 8 or 9 burners.

The brilliancy of a "sideral" reflector, illuminated by a lamp burning 50 grammes (1 ounce $12\frac{25}{100}$ drachms avoirdupois) of oil per hour, is equal to 4 burners. This brilliancy of the first is at least *double* that of the second.

The useful effect of the catadioptric apparatus of the 4th order, illuminating three-fourths of the circumference of the horizon, is represented by 137700. The useful effect of the sideral reflector is equivalent to 68400. Comparison of the second to the first =1 to 2. Economical effect of the catadioptric apparatus =3060. Economical effect of the sideral reflector =1368. Comparison of the second to the first =1 to 2·24. If we take for a term of comparison the ordinary reflector, (à coquille plate,) the superiority of the catadioptric apparatus will be still more decided. With regard to the concave parabolic reflectors, or photophores, I will not introduce them into this parallel, in consideration that they can only serve in isolated cases for the ordinary illumination of the entrances to harbors, upon an amplitude of not more than 20°.

[Apparatus of the 3d order smaller model.]

The apparatus of the 3d order, smaller size, illuminated by an ordinary fountain, or constant level lamp, carrying one burner and one wick, consuming 60 grammes (2 ounces $1\frac{9}{10}$ drachms avoirdupois) of oil per hour, or one burner with two wicks, consuming 115 grammes (4 ounces and 1

* In a previous part of the letter the author says:—

"1st. *The useful effect* of a parabolic reflector increases with its dimensions, and with that of the illuminating body.

"2d. *The economical effect* of a reflector of given dimensions is greatest when the lamp-burner is smallest.

"3d. *The divergence* is greatest when the flame is most voluminous, or when the reflector is smallest. We cannot, then, (all other things being equal,) augment the *economical effect* of a reflector, without diminishing its *useful effect*: that is to say, without reducing its brilliancy or intensity, and consequently its range. The reduction of the volume of light within certain limits is particularly objectionable when it appertains to eclipse apparatus; in which case it limits the width of the luminous cone, and consequently augments the length of the eclipses. The same reduction applied to the crowns (foci) of reflectors composing a fixed light apparatus, may weaken the light in their intervals to such a degree as to produce *dead angles*, or become completely obscured to the observer beyond certain distances.

"It is further proper to remark that the horizontal divergence is not lost for *useful effect*, but that the divergence in the vertical sense only profits the navigator in the limited angular space comprised between the tangent at the surface of the sea, and the ray terminating at the distance of some miles from the light.

"Finally, there is, for the calibre of the lamp burners applicable to reflectors of given dimensions, and destined for the illumination of an equally determined range, *a maximum* beyond which prodigality of light ensues, and *a minimum* within which the illumination becomes insufficient."

drachm) of oil per hour, have not equivalents in the catoptric apparatus in use at present.

A sideral apparatus of the same useful effect would be of a dimension which would render the construction of it very difficult, and very expensive, and would require, relatively, a very great consumption of oil. Neither could we supply it in a proper manner by the use of parabolic reflectors, except they were made expressly for the purpose of very small dimensions, to allow a sufficient number to distribute properly the light upon three-fourths of the horizon. It is evident, moreover, that that embarrassing combination would require a consumption of more than 200 grammes (7 oz.) of oil per hour.

The old light of Cette, (Herault,) provisionally illuminated by a catadioptric apparatus of 50 centimetres (19·69 inches) diameter, with a lamp of two concentric wicks, is easily seen in ordinary weather at the distance of 15 to 18 nautical miles, although it is given a range in the official table of only 12 nautical miles.

[Apparatus of the 3d order, larger model.]

The brilliancy of a catadioptric apparatus of the 3d order, one metre (39·38 inches) in diameter in the interior, illuminated by a mechanical lamp of double wick, burning 190 grammes (6 oz. 11·35 drachms) of oil per hour, has been found = 70 burners. I will suppose, moreover, that it embraces only four-fifths of the horizon.

To illuminate, by means of reflectors, the same angular space of 288°, with an effect of light *about equal*, it will be necessary to employ 14 parabolic reflectors (photophores) of 27·5c. (10·8 inches) diameter, each burning 35 grammes (1 oz. 3·8 drachms) of oil per hour. The brilliancy in the axis of each of the 14 reflectors will be about = 66 burners. The brilliancy in the interval, the least illuminated, will be = 36 burners. The useful effect will be represented by $14 \times 62160 = 870240$. But the useful effect of the catadioptric apparatus has been found to be = 1160000. In this case, notwithstanding the very great difference in the consumption of oil, the dioptric or lenticular apparatus is superior, in useful effect, to the catoptric apparatus. The economical effect of the first apparatus is represented by 6105, and the economical effect of the reflector is represented by 1776; comparison = 1 to 3·44: that is to say, without estimating the expenditure of oil by *unity of light*, the lenticular apparatus will be nearly three and a half times more advantageous than the catoptric apparatus. With regard to the effective expenditures of oil, they will be in the proportion of 190 grammes to 14×35 grammes, or of 1 to 2·6.

[Apparatus for a fixed light, 2d order.]

The brilliancy of a catadioptric apparatus of the 2d order, having an interior diameter of 1m. 40c., (4 feet 7·13 inches,) illuminated by a mechanical lamp of three concentric wicks, burning 500 grammes (17 oz. 10·5 drachms) of oil per hour, has been found to be = 264 burners. Let us suppose it only embraces three-fourths of the horizon. To obtain an effect about equal in an angular space of 270°, it will be necessary to employ at least 34 parabolic reflectors, having 50 centimetres (19·69 inches) diameter. The brilliancy in the axis of each of these 34 reflectors will be = 270 burners. But the lustres in the intervals are only = 148 burners. The

useful effect of the catadioptric apparatus will be represented by 4120000, and that of the 34 reflectors by $34 \times 103680 = 3525120$. The comparison between the absolute expenditures of oil will be $= \frac{34 \times 42}{500} = 2{\cdot}86$ to 1; and the comparison of the quantity of oil expended by unity of light $= \frac{2469}{8240} = 1$ to 3·33; thus, in this last respect, the lenticular apparatus will be three and one-third ($3\frac{1}{3}$) times as advantageous as the catoptric apparatus.

[Revolving apparatus of the 2d order.]

The maximum brilliancy or lustre of the revolving apparatus of the 2d order, with 12 lenses, has been found to be = 1184 burners, as follows:

1st. Brilliancy in the axis of a lens =	1080	burners.
2d. Brilliancy in the fixed catadioptric zones =	104	"
Total amount of brilliancy =	1184	"

And the minimum, corresponding to the eclipses, is equivalent to 104 burners.

To construct a catoptric apparatus possessing an equivalent effect, without multiplying beyond bounds the reflectors, (photophores,) it will be requisite, without doubt, to take those with diameters of from 55 to 60 centimetres, (21·66 inches to 23·63 inches,) but for want of sufficiently precise data as to their lustres, I will suppose the employment of reflectors of 50 centimetres (19·69 inches) diameter, which give in their axis a lustre equal to 270 burners. I will suppose, also, that the frame has six faces, each fitted with four of these reflectors. I will admit, lastly, as the succession of flashes ought to be the same in both systems, that the lenticular apparatus makes its revolution in six minutes, and the catoptric apparatus in three minutes. The maximum lustre of the catoptric system will be equal to $4 \times 270 = 1080$ burners. The amplitude of the lustres of the reflectors being, moreover, of 16 degrees at most, there will be 6 angles of 44 degrees each almost entirely obscured; and the length of these eclipses will be 22 seconds, while the length of the flashes will be only 8 seconds.

Without pressing further the comparison of the effects of the two kinds of apparatus, we will perceive, without doubt, the evident advantages of the dioptric or lenticular combination, which, in fine weather, will not present an *absolute eclipse* at a less distance than from 15 to 18 nautical miles. If we now consider the expenditures of oil, we will find:—

1st, That they are as $24 \times 42 : 500$, or :: 1 to 2.

2d, That the economical effects will be as 2469 : 10043, or as 1 to 4·07.

Thus the lenticular apparatus will be *four times* as advantageous as the catoptric or reflector apparatus.

I admit that this result might be modified by the employment of larger reflectors; but as their divergence would be less, the length of the flashes would be diminished, and consequently that of the eclipses would be augmented too much.

Let us remark, before proceeding further, that in employing 24 parabolic reflectors (photophores) of 50 centimetres (19·69 inches) diameter for

such an apparatus, we reach the utmost possible limit, without admitting the employment of lanterns of a size beyond all proper bounds; and we may also affirm that very few of the catoptric lights, considered as lights of the *first order*, equal the lenticular lights of the same character of the *second order*.

[Apparatus of the 1st order.]

With the view not to multiply unnecessarily the comparisons, I will omit the details relative to the first order of the catadioptric combination, which is the most advantageous; and I will suppose, in consequence, the lenticular apparatus fitted in its accessory part with 11 zones of fixed mirrors. Now, we have found that the total lustre or brilliancy of an apparatus of that kind is equal in all its azimuths to 480 burners. But it will be practically impossible to obtain a like effect in the catoptric system, without having recourse to the employment of 36 reflectors, with apertures (diameters) of 60 centimetres, (23·63 inches.)

The difficulty becomes still greater if it be necessary to attain, with these parabolic reflectors, the effect of a revolving lenticular light with 8 large lenses, the lustres or flashes of which exceed 4000 burners of the Carcel lamp.

Let us limit ourselves, then, without entering into more full details, to the observation that the economical effect of a fixed light of the first order, illuminating $\frac{3}{4}$ths of the horizon, is to the economical effect of a light composed of parabolic reflectors ("photophores") of 50 centimetres (19·69 in.) diameter, as 10·080 to 2·469, or as 4·08 to 1: that is to say, that the first will be (as to the expense of oil only) four times as advantageous as the second.

[Apparatus for lights varied by flashes.]

I will only refer here to the apparatus for lights varied by flashes, (otherwise called of short eclipses,) for the purpose of remarking that the catoptric or reflector system is not susceptible of producing, without great difficulty, that combination which unites to the permanence of fixed lights the advantage of presenting a very decided character.

SEC. 2. *Expenses of first establishing and of maintaining lighthouses.*—So far, I have compared the economical effects of the different kinds of apparatus only with reference to the expenditures of oil; but it will not fail to be objected that the advantages which I point out in favor of the lenticular system ought to be very greatly diminished in a fiscal point of view, in consequence of the high price of the apparatus, and the excess of keepers necessary to their service. To appreciate the value of that objection, I will compare several lights of both systems, taking into the account all the expenses to which they could be subjected, and for the first example I will take the harbor lights.

HARBOR LIGHTS.

A harbor light, placed at the entrance to a port, being often exposed to the force of the sea, ought (to insure proper attendance, &c.,) to be erected securely in a bronze lantern, fitted upon the summit of a small tower constructed of masonry, and sufficiently spacious for the purposes of illumination and attendance at all times, and in every description of weather.

That being established, we may state the expenses for first establishing for both systems, (in France,) as follows:—

1. *Small "Sideral" Light.*

Small tower, in masonry, - - - - - - -	5000 fr.
Octagonal lantern, 1m. 40c. (4 feet 7·13 inches) in diameter,	2650
"Sideral" reflector, with subsidiary pieces, - - -	500
= $1528·12.	8150
Interest at 5 per cent., - - - - - - - -	407 fr.
Annual expense of the service, - - - - - - -	800
= $226·31.	1207

2. *Catadioptric Harbor Light (smaller model.)*

Tower and lantern, - - - - - - - -	7650 fr.
Catadioptric apparatus, - - - - - - - -	1531
= $1721·43.	9181
Interest at 5 per cent., - - - - - - - -	459 fr.
Annual expense of the service, - - - - - - -	800
= $236·06.	1259

The useful effect of the "sideral" (reflector) light having been found equal to 68400—

Its economical effect will be represented here by $\frac{68400}{1207} = 57$.

The useful effect of the catadioptric light, illuminating $\frac{3}{4}$ths of the horizon, has been found to be equal to 137700.

After the same manner, its economical effect will be $\frac{137700}{1259} = 109$.

The comparison of the economical effects of these two will be, then, in the proportion of 57 to 109, or 1 to 1·91.

Then, besides the advantage of a double lustre or brilliancy, the catadioptric apparatus, in an economical point of view, is nearly twice as advantageous as the catoptric apparatus.

Lights of the third order.

It is difficult to establish a precise comparison between the fixed lights of the 3d order in the old and in the new system, because we cannot obtain with the ordinary parabolic reflectors a passably equal distribution of light, without multiplying these reflectors to such a number as would require a much greater expenditure of oil than could be allowed for lights of that class.

I will merely observe that I have every reason to believe, from the indications contained in the table of lighthouses in the United States, that

among all the lights of that country illuminated by reflectors, the diameters of which do not exceed sixteen English inches, there are very few whose useful effect is superior, or even equal to, that of a catadioptric light of the 3d order, larger model.

[Revolving lights of the second order.]

1st. Catoptric Light.

In the comparative examination of the useful and economical effects of the two systems of maritime illumination, I have supposed the revolving catoptric apparatus of the 2d order, composed of 24 parabolic reflectors of 50 centimetres (19·69 inches) of aperture distributed equally upon the six faces of a prismatic frame. I will suppose, also, that the lantern is 3 metres (9 feet 10·14 inches) in diameter, the same as required for a lenticular apparatus of the 2d order, but with a little less height. I will admit, moreover, the same perfection in the works: that is to say, that the frame and sashes, constructed of iron, are covered with bronze exteriorly; and that the roof or dome of the lantern is of copper, the glazing of glass of 8 to 10 milimetres (0·39 to 0·31 in.) in thickness, &c.

With regard to the buildings, the only remarkable difference will consist in, that the catoptric lighthouse will require room to lodge two keepers, while I will estimate for three in the lenticular lighthouse. That being stated, the necessary expenses to be incurred in the first system may be approximately estimated as follows:

Lighthouse tower, &c.,	50,000 fr.
Octagonal lantern, 3 metres (9 ft. 10·14 inches) in diameter, dressed in bronze,	10,500
Illuminating apparatus, consisting of 24 reflectors, 50 centimetres (19·69 inches) in diameter, revolving frame, rotary machinery, &c.,	12,500
Total first cost,	73,000
= $13,687·50.	
Interest at 5 per cent.	3650 fr.
Annual expense of the service, estimating the oil at the highest price,	5000
Total annual expense,	8650
= $1621·87.	

2d. Revolving lenticular apparatus of the second order.

Lighthouse tower, &c.,	60,000 fr.
Lantern and subsidiary fixtures,	12,500
Catadioptric lenticular apparatus and mechanical lamps,	33,000
Total first cost,	105,500
= $19,781·25.	
Interest at 5 per cent.,	5275 fr.
Annual expense of the service,	5800
Total annual expense,	11,075
= $2076·56.	

The useful effect of 24 parabolic reflectors of 50 centimetres (19·69 in.) diameter, will be equal to $24 \times 103680 = 2488320$.

The economical effect will be represented by $\frac{2488320}{8650} = 288$.

The useful effect of a lenticular light of the 2d order, with 12 revolving lenses, has been valued at 5021467.

The economical effect will then be represented by $\frac{5021467}{11075} = 453$.

The economical effects of these two lights will then be in the proportion of 288 to 453, or of 1 to 1·6. From whence it results definitively, that the lenticular light of the second order will be *more than one and a half times* as advantageous as the catoptric light, which we may, without doubt, consider as being of the first order, and the useful effect of which, nevertheless, could not be equal to but *the half* of the useful effect of the first.

Lights of the first order.

I find myself arrested in the attempt to make a comparison of the catoptric and dioptric lights of the first order, for the reason that we could not, without increasing beyond all proper limits the number of reflectors and the dimensions of the lantern, construct a catoptric apparatus to produce a sufficiently powerful effect to be assimilated to a dioptric apparatus of the first order. I mention this in this place merely that it may not be forgotten.

From the preceding details we may conclude:—

1st, That the lights fitted with the dioptric apparatus present a variety in their power and in their effects, and may be made to produce an intensity of lustre which renders them of an interest, in a nautical point of view, incontestably superior to those fitted with the catoptric apparatus.

2d, That if we take into account the first cost of construction, and the expense of their maintenance, we will find, in respect to the effect produced, the new system (dioptric) is still from *once and a half to twice as advantageous as the old.*

—

FACILITY AND SECURITY OF THE SERVICE OF THE LIGHTHOUSES OF THE OLD AND NEW SYSTEMS.

After having balanced the advantages relative to the two systems of lights in view of their useful and economical effects, I ought to consider them with reference to their security and the facility with which they are served.

I will reproduce, upon this subject, the observations inserted in a memoir of the 20th of April, 1830, in which I replied to the questions which were addressed to me by the government of Sweden and Norway, in relation to the necessary measures to be taken to improve the lighting of its maritime coasts.

"The service of lenticular lights is, in the aggregate, less laborious than that of the reflector lights. The first demand at all times during the night the unremitted attention of the keeper. If, for example, the central lamp should become extinct during the absence of the keeper from the lantern, or while he is asleep, the horizon of the light would remain some hours plunged in total darkness, and the greatest objection which has been urged

against our new system of illumination is the fear of such accidents. Happily, an experience of *seven years* has dissipated that fear, and the lenticular lights have been distinguished up to this time by the regularity of their service. However, every precaution has, besides, been taken to replace promptly the lamp or its burner in case of extinction. The extreme simplicity of the day duty compensates the keepers for that to which they are subjected during the night. To snuff and replace the wicks, renew the oil, sweep the chambers of the lantern and the stairs of the tower, dust the apparatus, and sometimes wash with a little spirits of wine the tarnished spots upon it, and, lastly, to wipe dry the glass of the lantern—such is the principal daily duty which is divided between the keepers of the new lights, and which rarely occupies them more than two hours."

Opinions thus expressed *fifteen years since*, based upon an experience of seven years, have been greatly strengthened up to the present time, embracing a period of *twenty-two years* since the establishment of the Cordouan light, and sustained by the results daily offered of more than *one hundred* lenticular lights of the three first orders, established along the coasts as well of France as of different foreign powers.

In this important point of view, then, the question seems to be irrevocably settled, and I will only add a few considerations relative to the application, more or less extended, which may be made of the new system of illumination to the vast maritime coasts of the United States.

1st, It has been objected that it would require too great sacrifices to be made to procure in that country keepers possessing the amount of intelligence requisite for the superintendence of lenticular lights.

2d, That, from distant points or stations, the necessary repairing and renewing of the mechanical lamps would be attended with great difficulty.

I will reply, with regard to the keepers, that the difficulty of obtaining proper persons to fill these subaltern stations appears to be most singularly exaggerated. In France they belong almost always to the class of *ordinary mechanics*, or laborers, who make from 1·50 francs to 2·50 francs (27 to 46 cents) per day.

Eight or ten days will suffice, ordinarily, to instrnct a light keeper in the most essential parts of his duty, receiving lessons from an instructor conversant with all the details of the service; and two instructing officers will be sufficient to prepare keepers for all the lenticular lights which could be successively established upon the coasts of North America. The information once imparted, would never be lost; and these officers might, besides, be aided by foremen or assistants, who could supply their places in case of necessity. In defence of this assertion I will cite the example of the administration of Norway and Sweden, which, after having obtained the assistance of a French agent to put up the apparatus of the two first lenticular lights, which were sent from Paris in 1832 and 1836, has provided since, without any foreign assistance, for the placing, as well as the organization of the service, of all the lights of the new system which it has successively established.

With reference to the eventual repairs of the mechanical lamps, it is to be considered—

1st, That, in consequence of the great strength of the pieces of which the new model of mechanical lamps are composed, they will perform well

for a number of years without requiring anything more than a proper attention to their cleanliness.

2d, That the ordinary assortment of a dioptric lighthouse comprises three of these lamps, which afford a sufficient guarantee against the chances of accident; and, besides, we may, by increasing a little the mean expense, increase the number to *four* under some circumstances, as an exception to the general rule.

3d, That the repairs of the implements under discussion may be easily made by all the clock or watchmakers, or other mechanicians, to whom we have recourse for repairing the revolving machinery of lighthouses.

I conclude with the remark, that if it be determined to multiply the application of the new system of maritime illumination in the United States, it seems to me that it will be expedient to *engage one of the foremen employed in the manufactory of our mechanical lamps to go to, and to remain in the country for several years.* By that measure, which would be attended with very little expense, all the difficulties which might present themselves at first in establishing lenticular lights would be removed, and the perfect regularity of the service of these new establishments would be insured.

LEONOR FRESNEL.

Paris, 31st December, 1845.

Report of Professors PIERCE *and* LOVERING, *of Harvard University, on Fresnel's Dioptric Apparatus for Lighthouses. February*, 1846.

To the President of the Boston Marine Society, the undersigned respectfully submit the following Report upon the Sea Lights exhibited by I. W. P. LEWIS, Esq.

We have carefully examined these lights, and find them to be identical with Fresnel's Catadioptric Lights, which are well known to European navigators, and which, after repeated and earnest investigations by men of the highest scientific character, and by those practically familiar with the subject of lighthouses, have been approved and adopted by the principal maritime powers of Europe, viz. France, Holland, England, Sweden, Denmark, Spain, Sardinia, and Naples.

They have, from the time of their introduction, been gaining the favor of the world, and there are now two hundred lighthouses furnished with them, and there is no complaint of their inadequacy to the wants of navigation. On the contrary, the universal testimony is that of unequivocal and decided approbation, and among the witnesses we find the names of two of the most accomplished officers of our own Navy, Lieuts. Blake and Gedney, and a distinguished officer of the Topographical Corps, Captain W. H. Swift.

Impressed with the deep importance of this subject to the welfare of commerce and the safety of the mariner, we have devoted much time to our own examination of the lights, and having no desire to arrive at one result rather than another, we have been subject to no bias in the investigation; our conclusions must therefore be regarded as those of an entirely independent authority, and it will be seen that they do not differ materially from those of the Bell Rock Committee, appointed by the British Board of Commissioners of Northern Lighthouses to investigate these lights, and who, under the guidance of Sir David Brewster, devoted three years

to this important examination. The executive member of this committee, and the one who arranged all the apparatus, was Robert Stevenson, Esq., whose official prejudices (as Chief Engineer of the Northern Lighthouses) were known to be strongly in favor of the old system of reflectors.

Our conclusions are also the same with those of Mr. Alan Stevenson, (who has succeeded his father as Chief Engineer,) and with those of Capt. Drummond, the inventor of the Drummond Light, and of Mr. Barlow, and of Fresnel himself.

The advantage of Fresnel Lights over the Reflectors is obvious and easy to be understood. It consists, primarily and simply, in catching those portions of light which are lost in the system of illumination by Reflectors, either because such portions pass too high into the upper regions of the air, or because they pass too low, and strike the earth at a short distance from the lighthouse. The light which is thus caught is thrown into a direction sufficiently near the horizon to become useful to navigation. The gain over the reflector is precisely similar in character to that of the reflector over the unaided light, and the light of the refractor or lens bears about the same ratio to that of the reflector which that of the reflector bears to the unaided light. Thus, $\frac{2}{3}\frac{9}{0}$ths of an open light must be lost, and only $\frac{1}{3}\frac{1}{0}$th would be practically useful to navigation, but the addition of a reflector of the best model and finish reduces the loss to $\frac{5}{8}$ths of the whole amount of light, and renders $\frac{1}{8}$th of the light practically useful. But the substitution of the Dioptric Apparatus reduces the amount of lost light to $\frac{1}{8}$th of the whole amount of light, and renders $\frac{5}{8}$ths of the light available: in other words, the serviceable portion of the open light is about $3\frac{1}{3}$ per cent., that of the best reflector is 17 per cent., and that of the Dioptric apparatus is 83 per cent. of the whole amount of light generated. This enormous superiority of the Dioptric apparatus is its characteristic feature, and constitutes the strong and unanswerable argument in its favor. The Dioptric light, under all circumstances, whether exhibited as *fixed*, *revolving*, *flashing*, or *intermittent*, gives *five times* the amount of light of the reflector for the same consumption of oil. (See Note.)

A secondary consideration of no little practical importance is the circumstance that the "*Fixed*" Dioptric Light is much more perfect than the "*Fixed*" Light by reflectors, because its light is diffused *equally in every direction.* This is not the case with the reflector, for if ten reflectors, for instance, of the best model, are arranged upon a circular stand as a fixed light, each lamp illuminates only a small portion of the horizon in front of its reflector. Hence not more than one lamp (of the ten) can be seen in any direction, and there are large intervals in which no lamp can be seen. The dark spaces are even larger in this case than the illuminated portions, so that only 42 per cent. of the whole horizon is lighted, and less than 20 per cent. is lighted with the full power of a single lamp. The Dioptric light, on the contrary, is seen in every direction with the same brilliancy. The only objection to the Dioptric light arises from the dependence upon a single lamp, fed by a mechanical contrivance. Any injury to the valves might extinguish the lamp, and it would take about twenty minutes to relight it. Experience seems, however, to have shewn that this danger is more speculative than real, for there is no public complaint of any such occurrence, nor are we informed of its having happened. We are also of

opinion that this danger might be avoided by the substitution of a large fountain lamp for the mechanical lamp.

Our attention has incidentally been drawn to the great inferiority of the reflectors generally used upon the American coast, by which the amount of available light is much less than one-half of that which would be given by a good reflector of suitable dimensions. The gain of the Dioptric light over such a reflector cannot be less than in the ratio of ten to one. Hence it is that Mr. Lewis has been able to exhibit the accompanying schedule of our northern lights, in which he fairly proposes to furnish nearly three times the amount of light with only about one-third of the present consumption of oil. With about 8800 gallons of oil, he gives nearly three times the amount of light actually furnished with 26,400 gallons, and as much light as, on the present wasteful system, would be derived from the consumption of 78,000 gallons of oil. In this proposition there is no mystery or deception, nor any reasonable room for doubt or distrust. The principles of this gain are admitted by all scientific men as incontestable, and admit of being tested by any man of good sense and decent acquirements.

We cannot close this report without expressing our deep sense of Mr. Lewis's thorough acquaintance with the whole subject of lighthouses, both theoretically and practically—of his openness and candor in every point of the investigation, and his anxious desire to aid us in arriving at the truth.

Most respectfully, your obedient servants,

BENJAMIN PIERCE.
JOSEPH LOVERING.

Harvard University, February 3d, 1846.

Note to Report.—This paper gives the result of our experiments, made for determining the comparative value of the Catoptric and Dioptric methods employed in lighthouses.

These experiments were carefully conducted, without any bias, and with no desire but to find the truth.

The apparatus was furnished by Mr. I W. P. Lewis, and arranged by him in working order, in the spacious hall over the new depôt of the Boston and Maine Railroad.

Our plan has been to compare the reflector with a Carcel flame placed at a given height, and then compare the Carcel flame with the Dioptric light. When possible, the Catoptric and Dioptric lights have been brought into direct comparison as a kind of verification of the first result.

Although the number of our experiments has not been very great, we place considerable confidence in our conclusions, from the time and attention bestowed upon them, and a satisfactory correspondence between them and those which have been reached by men who have more fully investigated the subject in Great Britain.

Our examination extended to the following articles of apparatus, viz:—

1st. An Annular Lens of the 1st Order, with lamp of 4 wicks.

2d. An Annular Lens of the 2d Order, with lamp of 3 wicks.

3d. A Cylindric Refractor, of the 3d Order, with lamp of 2 wicks.

4th. The same varied by flashes.

5th. A Catadioptric series of the 3d Order, small model, with an Argand lamp.